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THE LIMESTONE INDUSTRIES OF ONTARIO

By

D. F. HEWITT and M. A. VOS

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THE LIMESTONE INDUSTRIES OF ONTARIO

By

D. F. HEWITT

Revised by M. A. VOS and D. F. HEWITT, 1971

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1 inch to 16 miles.

Explanatory Notes and Glossaries of Terms

SCHEDULE FOR ROCK DESCRIPTION

The schedule for rock description used in this report is as follows:

Rock name, qualifying adjective or essential varietal characteristics; colour; grain size or crystallinity; bedding; characteristic features of structure, texture, or mineralogy such as cross-lamination, vugs, stylolites, pyrite, etc; fossils.

Example: Limestone: shaly; brownish grey,[1] medium grey weathering; aphanitic; medium bedded; stylolites, calcite crystals; abundant Tetradium.

CRYSTALLINITY CLASSIFICATION

Coarse Crystalline	Over 5 millimetres
Medium Crystalline	1 millimetre to 5 millimetres
Fine Crystalline	0.2–1 millimetre
Aphanitic	Under 0.2 millimetre; not detectable with the naked eye
Microcrystalline	0.05–0.2 millimetre; aphanitic with crystals detectable under 10× hand lens (=lithographic)
Cryptocrystalline	Under 0.05 millimetre; individual crystals only detectable under microscopic examination (=lithographic).

GRAIN-SIZE CLASSIFICATION (WENTWORTH CLASSIFICATION FOR CLASTIC FRAGMENTS)

Boulder	Over 256 millimetres (or 10⅛ inches)
Cobble	64–256 millimetres (2½–10⅛ inches)
Pebble	4–64 millimetres (⅜–2½ inches)
Granule	2–4 millimetres (5/16–⅜ inch)
Very Coarse-Grained	1 millimetre to 2 millimetres
Coarse-Grained	0.5–1 millimetre
Medium-Grained	0.25–0.5 millimetre
Fine-Grained	0.125–0.25 millimetre
Very Fine-Grained	0.0625–0.125 millimetre
Silt	0.004–0.0625 millimetre (settles rapidly in water).

BEDDING CLASSIFICATION

Massive-Bedded	Beds over 36 inches thick
Thick-Bedded	12–36 inches
Medium-Bedded	4–12 inches
Thin-Bedded	2–4 inches
Very Thin-Bedded	½ inch to 2 inches
Platy	1/16–½ inch
Fissile	Less than 1/16 inch.

[1]Colours follow the Rock Colour Chart as drawn up by the Rock Colour Chart Committee of the United States Geological Survey, the Geological Society of America, and other orgnizations.

CLASSIFICATION OF LIMESTONE AND DOLOMITE

The following classification is suitable for laboratory work:

TERM USED	CALCITE	DOLOMITE	MgO*
	percent	percent	percent
Limestone	95–100	0– 5	0 – 1.1
Magnesian Limestone	90– 95	5– 10	1.1– 2.1
Dolomitic Limestone	50– 90	10– 50	2.1–10.8
Calcitic Dolomite	10– 50	50– 90	10.8–19.5
Dolomite	0– 10	90–100	19.5–21.6

The following field classification is also used in this report:

FIELD TERM	DOLOMITE	MgO	CaO	CaO:MgO*
	percent	percent	percent	
Limestone	0– 10	0 – 2.1	56.0 –53.54	greater than 27:1
Dolomitic Limestone	10– 50	2.1–10.8	53.54–44.5	from 27:1 to 4:1
Dolomite	50–100	10.8–21.6	44.5 –30.4	from 4:1 to 1.4:1

*The CaO and MgO limits are true only if dealing with a pure stone; if impurities are present the CaO:MgO ratio is used.

The following terms are used for chemical limestone and dolomite:

High-Calcium Limestone. Limestone that contains less than 3 percent impurities (silica, iron, alumina, and other insolubles) and less than 2 percent magnesium carbonate.

High-Purity Dolomite. Dolomite that contains less than 3 percent impurities and at least 97 percent combined calcium and magnesium carbonates.

CLASSIFICATION OF CLASTIC LIMESTONES BY SIZE GRADATION

Calcirudite. A limestone composed of detrital calcium carbonate fragments predominantly larger than 4 millimetres in diameter. Also used for limestone conglomerate in some rocks where limestone pebbles occur in a calcarenite or calcilutite matrix.

Calcarenite. A limestone composed of clastic calcite grains and sorted fossil debris of sand size: i.e. the calcareous equivalent of a sandstone; generally shows cross-lamination.

Coquinoid Calcarenite. Calcarenite composed predominantly of sorted or partially sorted fossil debris, generally of sand-to-granule size. The matrix may be calcarenite to calcilutite.

Calcisiltite. A limestone composed of silt-size carbonate grains: midway in size between calcarenite (sand) and calcilutite (clay). Generally has a gritty feel or texture in contrast to calcilutite.

Calcilutite. A laminate limestone composed of clay-size and clay-to-silt size carbonate material of probable detrital origin; it results from lithification of calcium carbonate mud.

GLOSSARY OF GEOLOGICAL TERMS

Argillaceous. Clayey or containing clay or shaly material.

Bioherm. A mound-like or dome-like mass of reef-rock composed of sedentary organisms such as corals, algae, crinoids, stromatoporoids, etc., having a massive, non-bedded, porous lithology, surrounded by, and enclosed in, bedded limestone or dolomite of different lithologic character.

Biostrome. A massive tabular, flat, or lenticular mass of reef-rock rarely over 15 feet thick, composed of sedentary organisms such as corals, algae, crinoids, stromatoporoids, etc., enclosed in bedded limestone of different lithologic character.

Cherty. Carrying sparse to abundant nodules, lenses, or stringers of chert, a variety of microcrystalline to chalcedonic silica with conchoidal fracture.

Coquinoid. Characterized by abundant content of fossil debris.

Crossbedding. Bedding characterized by included minor beds that are oblique and inclined to the main stratification.

Cross-Lamination. Laminations confined to single beds and inclined to the general stratification.

Facies. Areally segregated parts of differing lithology belonging to any genetically related body of sedimentary deposits.

Reef. A massive limestone composed of sedentary organisms such as corals, algae, crinoids, bryozoa, etc., which developed in place as thick flat sheets (biostromes) or mounds or ridges (bioherms) on the sea floor. Usually enclosed in bedded limestone (or dolomite) of somewhat different lithology.

Shaly Partings. Thin laminae of shale between limestone beds.

Siltstone. A rock composed of over 50 percent silt-sized clastic grains.

Stylolite. Thin zig-zag irregular seams developed in limestone, usually coated with bituminous or shaly material.

GLOSSARY OF COMMERCIAL STONE TERMS

Riprap. Large angular blocks of quarry stone from 1 cubic foot (about 200 pounds) up to 10–12 tons in size. When riprap is individually placed and fitted on the face of a revetment wall, dike, breakwater, or pier, it is usually termed 'armour stone.'

Rubble. Angular blocks of quarry stone from 5 inches to 1 foot in diameter, generally with one smooth rock face, are termed rubble. This size of stone is also known as 'man-sized' or 'one-man stone', because it can be handled by one man, and is sometimes used for armour stone, walls, lime kiln feed, or 'tower stone' for pulp and paper mills.

Cut Stone or Dimension Stone. Stone cut or sawn into blocks of specified shape and size from large mill blocks. Commonly used for exterior and interior building stone.

Ashlar. Rectangular blocks of building stone up to about 1 foot or more in size, bounded by sawn, planed, or planar rock surfaces, used in walls or building facings. *Split Faced-Ashlar* is produced by splitting the stone in a guillotine to give a natural rock face. *Even-Course Ashlar* uses blocks of equal height for each course, although the blocks in the course may be of random length. *Random Ashlar* uses blocks of differing size and heights, giving irregularly and unequally spaced joints in the wall.

Ashlar is commonly produced in Ontario from 4- to 12-inch beds cut by saw or guillotine.

Flagstone. Large flat pieces of stone 1 to 3 inches in thickness generally rectangular in shape. Random Flagstone is irregularly shaped.

CRUSHED STONE

Crusher Run. Stone run through a crusher set to produce stone of a maximum $\frac{7}{8}$-inch size would be termed $\frac{7}{8}$-inch or $\frac{3}{4}$-inch crusher and would consist of crushed stone of a maximum size, but containing a complete range of sizes from $\frac{7}{8}$-inch to fines. There may be specification of the percentage and range of fines tolerated in crusher run.

Clear Stone. Stone accurately sized by screening, to remove sizes of stone larger and smaller than specified, is termed Clear Stone, in contrast to crusher run, which contains a variety of sizes. Various sizes of clear stone, e.g. 1-inch stone, $\frac{3}{4}$-inch stone, etc., may be blended to customer's specifications.

SIZES

The common commercial stone sizes are approximately as follows but may vary considerably from quarry to quarry, depending on the stone shape and number of sizes produced:

NOMINAL STONE SIZE	PASSES SCREEN	RETAINED ON SCREEN
2-inch stone	2½-inch	1¾- to 1⅞-inch
1½-inch stone	1¾- to 1⅞-inch	1¼-inch
1-inch stone	1¼-inch	⅞- to ¾-inch
¾-inch stone	1¼- to 1-inch	⅝-inch
⅝-inch stone	¾-inch	½-inch
½-inch stone	⅝-inch	5/16- to ⅜-inch
⅜-inch stone	½-inch	¼-inch
Chips (¼-inch stone)	5/16-inch	⅛-inch
Screenings	minus ⅛-inch	

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Geological Map
(back pocket)

Map 2264–(coloured)–Ontario Limestone Quarries, 1971. Scale 1 inch to 16 miles.

THE LIMESTONE INDUSTRIES OF ONTARIO, 1971

By

D. F. HEWITT[1] and M. A. VOS[2]

INTRODUCTION

The three principal limestone industries in Ontario are the crushed stone, lime, and portland cement industries. In 1970 the value of production from these industries was $102,719,572 surpassing any other industrial mineral in value. In 1950 the production of crushed limestone amounted to 5,254,219 tons. By 1970 this had increased five-fold to 26,517,386 tons. In addition to the limestone used as crushed stone, in 1970 a further 4,668,139 tons was used in the manufacture of portland cement, and 1,700,279 tons in the manufacture of lime.

The great expansion of the limestone industries in the past two decades since World War II has been due largely to increased activity of the construction, chemical, and metallurgical industries, which are the chief users of limestone and limestone products. Limestone and dolomite have a very important place in our industrial economy, and their uses are many and varied. The chief use, both directly and indirectly, is in the construction industry, where, as well as being an excellent building stone, they provide crushed stone for roads, and asphalt and concrete aggregate. Limestone is the primary raw material for the lime and portland cement industries. It is the most common stone used for metallurgical flux in the steel industry. Dolomite is used for refractory manufacture. In the chemical industry, lime is the most important alkali and is used in a variety of chemicals such as soda ash, calcium chloride, calcium cyanamide, and calcium carbide. Smaller amounts of limestone and lime are used in the glass, pulp and paper, sugar refining, and tannery industries, as well as for cyanidation in the gold mining industry. A substantial amount of lime is used in the uranium milling process in Ontario uranium mines.

This report presents the results of a survey of Ontario limestone quarries made in 1970 and 1971. The results of previous surveys in 1958 and 1963 were published in 1960 and 1964 (Hewitt 1960; 1964). On the accompanying map (Map 2264, back pocket) 101 limestone quarries are listed and plotted on the map. Whereas the number of quarries in the province has remained about the same since the last survey in 1963, the rate of production from the individual quarries has in many cases increased markedly. In 1970 there were 11 quarries each producing over 1,000,000 tons of limestone annually, and 3 of these produced in excess of 2,000,000 tons each. In 1970, 23 quarries in Ontario produced over 500,000 tons. This is an increase from 15 in 1962.

The principal production of limestone comes from 4 stratigraphic horizons: the Guelph-Lockport-Amabel Dolomite of Silurian age, the Simcoe Group (Trenton-Black River) Limestone of Ordovician age, the Dundee-Detroit River Limestones of Devonian age, and the Bois Blanc Limestone and Bertie Dolomite of Devonian and Silurian age. A small production also comes from the Beekmantown Dolomite of Ordovician

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age and from the Precambrian marbles. A stratigraphic breakdown of the percent of stone supplied by each of these geologic horizons is given in Table 1.

Table 1 STRATIGRAPHIC BREAKDOWN OF LIMESTONE PRODUCTION, 1970

GEOLOGICAL FORMATIONS	APPROXIMATE NUMBER OF QUARRIES	TONNAGE	PERCENTAGE OF TOTAL TONNAGE
Guelph-Lockport-Amabel	17	12,699,082	41.8
Simcoe Group	18	7,891,178	26.0
Dundee-Detroit River	7	5,278,467	17.4
Bois Blanc-Bertie	8	3,461,894	11.4
Beekmantown	4	822,645	2.7
Precambrian	5	198,474	0.7

Production and Use of Limestone in Ontario

The production and value of limestone produced in Ontario from 1950 to 1970 is given in Table 2. The figures do not include limestone used for the manufacture of lime or portland cement. Although the tonnage and value have increased five-fold over the past twenty years the average value per ton for limestone has remained remarkably stable. This is a tribute to the increased efficiency of the quarry operations and contrasts with the rise in prices in other industries.

Table 2 PRODUCTION OF LIMESTONE IN ONTARIO, 1950–1970 (*exclusive of that used for lime and cement*)

YEAR	TONNAGE	VALUE	VALUE PER TON
1950	5,254,219	$ 6,192,498	1.17
1951	7,531,536	8,513,829	1.13
1952	7,524,832	8,800,659	1.17
1953	8,390,852	10,359,697	1.24
1954	9,816,205	11,446,494	1.17
1955	12,233,140	14,765,784	1.21
1956	15,217,629	19,316,877	1.27
1957	16,593,015	19,748,013	1.19
1958	15,220,361	18,677,112	1.23
1959	16,322,071	19,363,443	1.18
1960	16,118,571	18,782,082	1.17
1961	16,654,878	19,242,067	1.15
1962	17,279,797	19,892,022	1.15
1963	19,205,898	20,544,057	1.07
1964	22,217,344	25,243,229	1.14
1965	23,241,567	27,227,844	1.17
1966	23,813,409	27,685,394	1.17
1967	24,088,653	27,218,197	1.13
1968	26,538,776	31,408,180	1.18
1969	26,202,850	28,638,664	1.09
1970	26,517,386	30,428,000	1.15

The production and use of limestone in Ontario in 1970 is given in Table 3. As indicated in this table, the four main uses of limestone, namely crushed stone, flux stone, lime, and portland cement consume nearly 98 percent of the limestone quarried. Consumption of crushed stone for roads, concrete, and asphalt aggregate was 23,814,873 tons in 1970, making up 72.4 percent of total limestone production. Consumption of limestone for cement stood at 4,668,139 tons or 14.2 percent. Consumption of limestone for production of lime was 1,700,279 tons or 5.2 percent of the total production. Miscellaneous uses accounted for the other 2.3 percent of production.

Table 3 PRODUCTION AND USE OF LIMESTONE IN ONTARIO, 1970

USE	TONNAGE	PERCENT OF TOTAL
Crushed stone	23,814,873	72.4
Flux stone	1,937,312	5.9
Building stone	18,618	
Riprap	305,535	
Asphalt filler	50,902	
Pulverized stone	195,273	
Glass industry	125,410	2.3
Agricultural limestone	44,292	
Poultry grit	3,792	
Pulp and paper	13,910	
Other	7,469	
Sub-total	26,517,386	
Cement industry	4,668,139	14.2
Lime industry	1,700,279	5.2
Grand total	32,885,804 tons	100 percent

A list of limestone quarries operated in Ontario in 1970, that produced over 100,000 tons during the year, is given in order of production in Table 4. There were 46 quarries producing over 100,000 tons. Eleven quarries produced over 1,000,000 tons in

1970 and 23 quarries produced over 500,000 tons. There is a trend towards large annual production from established quarries near urban areas and in areas where transportation facilities are good.

Table 4 — LIMESTONE QUARRIES PRODUCING OVER 100,000 TONS IN 1970

ORDER OF PRODUCTION	NAME
	Group 1: over 1,000,000 tons per year
1.	Dufferin Materials & Construction Ltd. (Milton)
2.	Nelson Crushed Stone
3.	Canada Crushed Stone (Dundas)
4.	Indusmin Ltd. (Acton)
5.	St. Lawrence Cement Co. Ltd. (Ogden Point)
6.	Limestone Quarries Ltd.
7.	Francon Limited
8.	Port Colborne Quarries Ltd.
9.	Cyanamid of Canada Ltd.
10.	Allied Chemical Canada Ltd.
11.	Milton Quarries Ltd.
	Group 2: 500,000 to 1,000,000 tons per year
12.	Lake Ontario Cement Ltd.
13.	Domtar Chemicals Ltd. (Beachville)
14.	Vineland Quarries and Crushed Stone Ltd.
15.	Cayuga Materials & Construction Ltd.
16.	Steel Company of Canada Ltd. (Ingersoll)
17.	Indusmin Ltd. (Halton)
18.	Amherst Quarries Ltd.
19.	St. Catharines Crushed Stone Ltd.
20.	Dufferin Materials & Construction Ltd. (Hagersville)
21.	Walker Brothers Quarries
22.	Canada Cement Lafarge Limited (Belleville)
23.	Municipal Sand and Gravel Co. (now W. B. Bennett)
	Group 3: 100,000 to 500,000 tons per year
24.	Armstrong Bros. Co. Ltd. (Ottawa)
25.	St. Marys Cement Co. Ltd. (St. Marys)
26.	St. Marys Cement Co. Ltd. (Bowmanville)
27.	Queenston Quarries (Queenston)
28.	Canada Cement Lafarge Ltd. (Woodstock)
29.	Haldimand Quarries and Construction Ltd.
30.	R. E. Law Crushed Stone Ltd.
31.	Geo. C. Campbell Quarries
32.	Woods Sand and Gravel Ltd.
33.	Armstrong Bros. Co. Ltd. (Vinemount)
34.	A. Cope & Sons Ltd.
35.	Bertrand & Frere
36.	Domtar Chemicals Ltd.
37.	Brundige Construction Co.
38.	Dibblee Const. Co.
39.	Dominion Magnesium Ltd.
40.	Frazer Duntile Ltd.
41.	Permanent Concrete Ltd.
42.	Dunnville Rock Products Ltd.
43.	Armstrong Bros. Co. Ltd. (Marmora)
44.	McKean Quarries
45.	Flamboro Quarries
46.	Cornwall Gravel Co.

The Portland Cement Industry in Ontario

The production of portland cement in Ontario from 1950 to 1970 is given in Table 5. Production has increased from 930,000 tons valued at $10,953,896 in 1950, to 3,142,511 tons valued at $58,481,550 in 1970. There has been a three-fold increase in tonnage, and during the same period a substantial increase in price is also noted.

There were six portland cement plants in operation in Ontario in 1971, as listed in Table 6.

In 1970, portland cement production was running at 61 percent of rated annual capacity. Capacity has increased from 3,270,000 tons per year in 1963 to 5,142,750 tons at present. Since the survey of 1963 the Canada Cement Company plant at Port Colborne has been closed down. Canada Cement Lafarge Limited has announced that a new $50,000,000 dry process cement plant with a capacity of 1.1 million tons per year will be built at Bath, Ontario, near Kingston. The Belleville plant is expected to close. Since 1963 Lake Ontario Cement Company has added a third kiln to greatly increase capacity.

Table 5 — PRODUCTION OF PORTLAND CEMENT IN ONTARIO, 1950–1970

YEAR	TONNAGE	VALUE	PRICE PER TON
1950	930,000	$10,953,896	$11.75
1951	950,000	12,494,677	13.10
1952	975,000	14,142,060	14.50
1953	1,240,000	18,497,744	14.90
1954	1,262,000	18,958,173	15.00
1955	1,342,000	19,707,042	14.65
1956	1,450,000	21,455,019	14.80
1957	2,211,887	33,505,994	15.15
1958	2,400,158	35,195,552	14.60
1959	2,386,334	31,731,767	13.30
1960	2,007,044	30,699,800	15.30
1961	2,226,923	35,671,569	16.00
1962	2,510,783	38,704,090	15.40
1963	2,552,665	39,551,719	15.50
1964	3,043,771	46,804,126	15.40
1965	3,145,873	50,055,554	15.90
1966	3,242,591	52,680,630	16.20
1967	2,894,483	47,597,495	16.50
1968	3,103,849	53,683,873	17.30
1969	3,112,697	56,650,012	18.20
1970	3,142,511	58,481,550	18.60

St. Lawrence Cement Company at Clarkson also added a third kiln, a dry process kiln, which raised the plant capacity to 1,750,000 tons per year. St. Marys Cement Company built a new cement plant at Bowmanville, Ontario, which went to production in 1968. This new plant is described later in the text.

Table 6 PORTLAND CEMENT PRODUCERS IN ONTARIO, 1971

COMPANY	LOCATION	NO. OF KILNS	APPROXIMATE ANNUAL CAPACITY IN TONS
Canada Cement Lafarge Limited	Belleville	3	770,000
Canada Cement Lafarge Limited	Woodstock	2	595,000
Lake Ontario Cement Company	Picton	3	900,000
St. Lawrence Cement Company	Clarkson	3	1,750,000
St. Marys Cement Company	St. Marys	5	743,750
St. Marys Cement Company	Bowmanville	1	384,000
		Total	5,142,750 tons

The Lime Industry in Ontario

The production of quicklime and hydrated lime in Ontario from 1950 to 1970 is given in Table 7. Production of lime has increased from 571,490 tons valued at $6,030,228 in 1950, to 1,163,675 tons valued at $13,810,022 in 1970.

The production and use of lime in Ontario in 1970 is given in Table 8. The largest users of lime are the chemical industries, followed closely by the iron and steel industry. A large tonnage of hydrated lime is used in the building trades. Uranium milling continues to be a large consumer of lime although not on the scale of former years when uranium production was higher.

In 1970 there were eleven lime plants in operation in Ontario. Two of these, Algoma Steel Corporation and Reiss Lime Company, import their stone from the United States. All other plants, except that of Cyanamid of Canada Limited at Niagara Falls, are operated in conjunction with a quarry operation on the property or nearby. The stone for the Niagara Falls lime plant is shipped in from Beachville, Ontario.

Table 7 PRODUCTION OF LIME IN ONTARIO, 1950–1970

YEAR	QUICKLIME		HYDRATED LIME		TOTAL VALUE
	TONS	VALUE	TONS	VALUE	
1950	479,993	$ 4,682,551	91,497	$1,347,677	$ 6,030,228
1951	527,382	5,497,302	92,387	1,424,614	6,921,916
1952	535,463	5,340,146	86,816	1,580,916	6,921,062
1953	556,644	6,007,156	102,418	1,707,096	7,714,252
1954	503,926	5,771,697	106,665	1,909,042	7,680,739
1955	592,222	6,436,311	106,023	1,984,071	8,420,382
1956	556,465	6,182,108	116,892	2,076,749	8,258,857
1957	657,732	7,442,153	108,411	1,974,715	9,416,868
1958	883,707	10,295,151	126,209	2,349,774	12,644,925
1959	1,004,264	11,597,018	125,791	2,409,514	14,006,532
1960	885,738	10,242,812	104,350	2,035,818	12,278,630
1961	760,785	9,572,729	104,345	1,975,403	11,548,132
1962	802,385	8,458,842	108,545	2,069,068	10,527,910
1963	847,692	9,295,579	105,253	2,138,644	11,434,223
1964	934,731	10,579,321	115,067	2,548,229	13,127,550
1965	1,041,788	11,295,729	117,405	2,546,440	13,842,169
1966	963,458	9,949,325	114,892	2,283,542	12,232,867
1967	881,395	9,224,561	93,063	1,877,113	11,101,674
1968	899,860	9,455,458	113,852	2,316,502	11,771,960
1969	1,014,795	10,045,783	114,479	2,387,820	12,433,603
1970	1,064,952	11,743,479	98,723	2,066,543	13,810,022

The most important source of high purity calcium limestone for the production of high purity calcium lime is the Detroit River Limestone of Devonian age, which is quarried at Beachville, Ingersoll, and Amherstburg for use by Allied Chemical Canada Limited, Cyanamid of Canada Limited, Domtar Chemicals Limited, and the Steel Company of Canada Limited. The high purity Guelph Dolomite is quarried by Domtar Chemicals Limited at Hespeler (Glenchristie) and by Canadian Gypsum Company at Guelph. These companies produce dolomitic lime mainly for the building trades. Precambrian marble is quarried for lime production by Bonnechere Lime Limited and Dominion Magnesium Limited. The latter company uses the dolomitic lime for the manufacture of magnesium metal.

Table 8 PRODUCTION AND USE OF LIME IN ONTARIO, 1970

USE	QUICKLIME		HYDRATED LIME	
	TONS	DOLLARS	TONS	DOLLARS
Building trades	278	10,254	46,962	1,198,491
Agriculture	....	....	2,760	43,700
Road stabilization	3,700	21,211	....	....
Smelters	17,193	212,693	4,010	41,600
Iron and steel plants	341,719	4,238,467	....	....
Gold milling	10,792	120,665	....	....
Uranium milling	24,566	317,866	1,390	22,000
Pulp and paper	665	9,445	2,540	39,200
Sugar	468	5,233	....	....
Tanneries	....	....	3,110	52,790
Fertilizer and insecticides	7,500	78,930	730	9,250
Chemical industries	571,033	5,647,640	37,221	659,512
Other	87,388	1,081,075	....	....
Total	1,064,952	11,743,479	98,723	2,066,543

Table 9 ONTARIO LIME PRODUCERS, 1970

COMPANY	LOCALITY	TYPE OF LIME	NO. & TYPE OF KILN	PLANT CAPACITY IN TONS PER 24 HOURS
Algoma Steel Corp.	Sault Ste. Marie	calcium	1 rotary	275
Allied Chemical Canada Ltd.	Amherstburg	calcium	5 stack	1,250
Bonnechere Lime Ltd.	Carleton Place	calcium	1 stack	8
Canadian Gypsum Co.	Guelph	dolomite	15 stack	170
Cyanamid of Canada Ltd.	Niagara Falls	calcium	7 rotary	700
Cyanamid of Canada Ltd.	Beachville	calcium	1 rotary	325
			1 calcimatic	300
Dominion Magnesium Ltd.	Haley	dolomite	2 rotary	170
Domtar Chemicals Ltd.	Beachville	calcium	6 stack)	1,200
			2 rotary)	
Domtar Chemicals Ltd.	Hespeler	dolomite	11 stack	211
Reiss Lime Co.	Serpent R.	calcium	1 rotary	250
Steel Co. of Canada	Ingersoll	calcium	3 stack	360

ONTARIO LIMESTONE QUARRIES

The principal limestone and dolomite formations being quarried commercially in Ontario are the following, listed in order from the oldest to the youngest:

1. Precambrian Grenville Marble;
2. Beekmantown Dolomite;
3. Simcoe Limestone (Black River-Trenton);
4. Guelph-Lockport-Amabel Dolomite;
5. Bois Blanc Limestone and Bertie Dolomite;

6. Detroit River and Dundee Limestone and Dolomite.

The stratigraphic breakdown of limestone production in 1970 in Ontario was given in Table 1. The distribution of all these geological formations is indicated on Map 2264 (back pocket) that accompanies this report. The geological column for southern Ontario is given on the map.

Precambrian Grenville Marble

Precambrian marble deposits of the Grenville Series are of widespead occurrence in eastern Ontario. Both calcitic and dolomitic marble are quarried. The marbles range in grain size from fine to coarse, depending on the degree of metamorphism. Colour is extremely varied; white and grey are common, but pink, green, yellow, buff, red, blue, and black are also quarried. Some of the Grenville marbles are of high purity; others contain mica, lime silicates, garnet, serpentine, pyrite, magnetite, and other impurities.

Companies reporting production of Grenville marble in Ontario in 1970 are listed in Table 10.

Table 10 — GRENVILLE MARBLE QUARRIES IN ONTARIO, 1970

1. Bolenders Limited, Eagle Lake
2. Bonnechere Lime Limited, Carleton Place
3. Canada Talc Industries Limited, Madoc
4. Dominion Magnesium Limited, Haley
5. Stoklosar Marble Quarries Limited, Madoc

QUARRIES

Bolenders Limited (11)*

EAGLE LAKE

Bolenders Limited operates quarries on lots 24 and 25, concession IV, Guilford Township, Haliburton County. A description is given by Hewitt (1964, p.13). Quarry products now include precast concrete facing. Dust, ⅛-inch and 1/16-inch crushed stone form the base for compressed brick. A white concrete brick made with cement is marketed by Dunbrick in Oshawa. The ⅛-inch and the 1/16-inch crushed stone are sold for sand traps in golf courses. A primary Traylor jaw crusher, 28 by 36 inches, reduces the stone to minus 4-inch; this stone is stored for winter production or transported directly to a secondary Mitchell jaw crusher, size 14 by 18 inches, located on the slope of a hill. Screening, additional crushing in a 1½-foot Symons cone crusher, and transport to bins for various sizes, is carried out with the benefit of gravity. A bucket elevator reroutes oversizes to the crusher.

Trucks or railways cars can draw from the bins at road level. Crushers handle dolomite as well as quartzite. The products are shipped in bags or bulk. Two belt packers and one compressed air packing machine for stone dust are available. A dust control unit has been installed in the screening house. Drilling is carried out by a Gardner-Denver Air Trac drill, drilling 2½-inch holes in a 4-foot pattern in both quarries.

Bonnechere Lime Limited (12)

CARLETON PLACE

The operation of Bonnechere Lime Limited is described by Hewitt (1964, p.17) under the name Carleton Lime Products Company.

Canada Talc Industries Limited (24)

MADOC

White, fine-grained dolomitic marble is mined by Canada Talc Industries Limited at the Conley Mine, on lot 15, concession XIV, Huntingdon Township,

*Number in brackets after a company name refers to the property number as shown on Map 2264, back pocket.

Hastings County. The principal use is for terrazzo chips. Some pulverized marble products are also produced.

Dominion Magnesium Limited (42)

HALEY

Hewitt (1964, p.17-18) described the operation of Dominion Magnesium Limited, 2½ miles northeast of Haley Station. Magnesium metal is produced from dolomite quarried locally. Calcium metal, the second biggest product, is made from calcium lime brought in from Beachville.

Two quarries have been opened on the property, the second one to the north of the first quarry and slightly east due to a minor offset of the north-trending dolomite deposit along an east-west fault. The north quarry was not in production in July 1969. Selective quarrying is here necessary because of the presence of some lenses of black schist. Manganous dolomite together with a 3-foot wide calcite vein contaminate the ore on the eastern (hanging wall) side.

The original quarry has reached a depth of 100 feet.

Stoklosar Marble Quarries Limited (98)

MADOC

Stocklosar Marble Quarries Limited operate a mill for the production of marble terrazzo chips on Highway 62, a mile north of Madoc. The company mines black, green, buff, white, chocolate brown, and pink marble from several small quarries in the Madoc area.

Beekmantown Dolomite

The main area of Beekmantown Dolomite of commercial interest, in Ontario, is on the west flank of the Ottawa-St. Lawrence Basin and extends from Ottawa to Brockville, underlying part of Carleton, Dundas, Grenville, Leeds, and Lanark Counties.

The Beekmantown Dolomite of the Ottawa-St. Lawrence Basin is divided into a lower March Formation, consisting of interbedded grey dolomite, sandy dolomite, and sandstone, and an upper Oxford Formation, consisting of thick-bedded dolomite and dolomitic limestone. The March Formation constitutes transition beds from the underlying Nepean Sandstone to the overlying Oxford Dolomite and attains a maximum thickness of about 30 feet (Wilson 1946, p.12-14). The Beekmantown Dolomite (Oxford plus March Formations) has a thickness of 240 to 350 feet. The Beekmantown Dolomite is overlain by the Rockcliffe Formation, consisting of shale and sandstone of Chazyan age.

Armstrong Brothers Company Limited (5)

OTTAWA QUARRY

The quarry operated by Armstrong Brothers Company on lots 24 and 25, concession V, Gloucester Township, Carleton County, is described by Hewitt (1964, p.26).

The quarry has been deepened. An additional 9½ feet of thick- to massive-bedded, medium grey to medium brownish grey, fine crystalline Beekmantown Dolomite with shaly partings and calcite crystals, in a few places, has been added to the upper lift. Of a 24-foot deep lower lift 11.5 feet were exposed above the water level, comprised of medium grey to medium dark grey, fine crystalline to aphanitic dolomite. The dolomite is medium- to thick-bedded with minor shaly partings and a few calcite crystals in the upper part.

QUARRY OPERATION

Drilling is done on a 6- by 6-foot pattern by a Gardner-Denver Air Trac drill, drilling 2¾-inch holes. The rock is hauled by eight 15-cubic yard Euclid dump trucks that are loaded at the face by a 1½-cubic yard Link Belt shovel. Crushing and screening is done by a portable plant with a Cedarapids primary crusher, a Symons Standard cone crusher, and two Symons shorthead crushers.

Concrete and asphalt aggregate are produced. Occasionally a portable pre-mixed concrete or asphalt plant is brought in.

Bertrand and Frere Construction Company Limited (9)

OTTAWA QUARRY

A quarry is operated by Bertrand and Frere Construction Company Limited in Gloucester Township, 9½ miles southeast of Ottawa. The quarry is located in lot 27, concession V, Gloucester Township, Carleton County.

The 24.5-foot quarry face intersects a series of dolomites of the Oxford Formation similar to that excavated by Dibblee Construction Company, ½ mile to the northwest. Dark grey to brownish grey dolomite with calcite crystals, and some pyrite near the top, is exposed. The section is described in Table 11.

Chemical analyses of chip samples of the quarry face are given in Table 12.

QUARRY OPERATION

The quarry is operated on demand with portable equipment. When visited in July 1971 none of the equipment was present. Some stockpiles of crushed stone were available and an area surrounding the initial quarry opening had been stripped in preparation of further blasting. There is from 1 to 3 feet of clay and weathered stone overlying the even, horizontal, bedrock surface.

Brundige Construction Company (13,14)

ATHENS QUARRIES

Brundige's quarry on lot 14, concession IX, Rear of Yonge and Escott Township, Leeds County, described by Hewitt (1964, p.22), was not active in July 1969. Production in the Athens area was obtained from a second quarry located on lot 15, concession X of the above township, approximately 2¼ miles northwest of Athens. The latter quarry, also described by Hewitt (1964, p.22), has been deepened to about 22 feet. The section is described in Table 13.

Chemical analyses of chip samples of the face of the quarry are given in Table 14.

QUARRY OPERATION

Crushing and screening is done by a portable Cedarapids Commander crushing and screening plant; a ¾-cubic yard Lorain front-end loader is available on the property. Products are ½-inch chips from the upper 7.5 feet of sandstone and dolomite and asphalt aggregate from the lower beds.

A portable Standard Steel asphalt batching plant with a capacity of 700 to 800 tons per day is brought in when needed.

Brundige Construction Company (15)

FERGUSON CORNERS

A quarry has been operated at Ferguson Corners, on lot 24, concession III, Augusta Township, Grenville County, 3 miles north of Maitland, by Brundige Construction Company.

The Brundige property, also referred to as Maitland quarry, is described by Hewitt (1964, p.25-26).

The quarry has been deepened by 13½ feet into medium brownish and medium light grey dolomite of the Oxford Formation. The section is described in Table 15.

A chemical analysis of a chip sample of the lower part of the quarry face is given in Table 16.

QUARRY OPERATION

A portable crushing and screening plant fed from the face by a 3¼-cubic yard Euclid front-end loader is operated in the quarry. The plant is equipped with a conveyor belt and a loading bin for trucks.

A portable asphalt plant was on site at the time of visiting.

Table 11 — QUARRY SECTION — BERTRAND AND FRERE CONSTRUCTION COMPANY LIMITED, OTTAWA QUARRY

UNIT	DESCRIPTION	THICKNESS FEET
Oxford Formation		
BG1	Dolomite: medium dark grey to dark brownish grey, grey to brown weathering; fine crystalline to aphanitic; medium to thick bedded; calcite crystals; upper 6 feet thin to medium bedded with black shaly parting and in places pyrite; from 2 to 3.2 feet light grey weathering, colour banding	24.5

Table 12 CHEMICAL ANALYSES – BERTRAND AND FRERE CONSTRUCTION COMPANY LIMITED, OTTAWA QUARRY

FEET ABOVE FLOOR	COMPONENTS IN PERCENT							
	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	L.O.I.	TOTAL	CO_2
12.2–24.5	11.4	5.24	1.06	17.0	24.3	37.2	96.20	36.5
0 –12.2	8.84	3.00	1.20	16.8	27.2	39.6	96.64	39.4

Table 13 QUARRY SECTION – ATHENS QUARRY NO. 2

UNIT	DESCRIPTION	THICKNESS FEET
March Formation		
BA2	Sandstone and Dolomite: predominantly dolomitic sandstone; light grey, grey weathering at base; brown and grey, or greenish grey mottled, and buff weathering in upper part; 0.2 feet of shale in between at 3.3 feet; medium to thick bedded; glauconite and calcite crystals from 3.5 to 6.1 feet	7.5
BA1	Dolomite: brown to brownish grey; medium bedded; fine crystalline; calcite crystals throughout, abundant in upper 2 feet; in places buff or greenish grey colour banding; glauconitic towards base; bottom 3 feet not exposed	14.5
	Total height	22.0

Table 14 CHEMICAL ANALYSES – ATHENS QUARRY NO. 2

FEET ABOVE FLOOR	COMPONENTS IN PERCENT							
	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	L.O.I.	TOTAL	CO_2
10.9–22	26.9	2.87	0.56	9.95	26.3	31.0	97.58	30.7
3 –10.9	21.0	3.39	0.56	12.0	26.7	33.9	97.55	32.7

Table 15 QUARRY SECTION – MAITLAND QUARRY, BRUNDIGE CONSTRUCTION COMPANY, FERGUSON CORNERS

UNIT	DESCRIPTION	THICKNESS FEET
Beekmantown Dolomite		
BM3	Dolomite: medium brown to grey, buff weathering; aphanitic to medium crystalline; thin bedded	8.0
BM2	Dolomite: medium brownish grey, brown weathering; fine to medium crystalline; medium bedded, laminated; minor shaly partings; calcite crystals	6.4
BM1	Dolomite: medium brownish to medium light grey, grey weathering; fine to medium crystalline; thick bedded; minor shaly partings	7.1
	Total	21.5

Table 16 CHEMICAL ANALYSIS – MAITLAND QUARRY, BRUNDIGE CONSTRUCTION COMPANY, FERGUSON CORNERS

FEET ABOVE FLOOR	COMPONENTS IN PERCENT								
	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	P_2O_5	SO_3	L.O.I.	TOTAL
0–13.5	8.67	1.47	0.54	17.0	29.3	0.03	0.24	41.9	99.2

Brundige Construction Company (16)

HARLEM QUARRY

The Harlem quarry of Brundige Construction Company is on lot 15, concession VI, Bastard Township, Leeds County, ½ mile south of Harlem.

The quarry was inactive when visited and partly flooded. It appeared that the flooded part had been deepened by at least 5 feet since being reported on by Hewitt (1964, p.20-21).

Brundige Construction Company (17)

JASPER

The Jasper quarry of Brundige Construction Company is on lot 29, concession I, Wolford Township, Grenville County, ½ mile north of Jasper.

It is described by Hewitt (1964, p.19). The 20-foot face is quarried in one lift.

QUARRY OPERATION

Drilling of 2½-inch holes is done by Gardner-Denver Air Trace drill. Blasting agents are dynamite with prilled ammonium nitrate. A 3½-cubic yard Lorain front-end loader is used for loading stone at the quarry face. Two dump trucks haul rock to a Cedarapids primary jaw crusher. A secondary Cedarapids Junior Commander crushing and screening plant with jaw and roll crushers and a 2-deck, 4- by 14-foot, screen is supplied with three hoppers with loading belts. A washing plant for washing chips is available.

Loading at the stockpiles is done by a 2-cubic yard Lorain front-end loader. Products include concrete- and asphalt-aggregate Granular 'A', ⅝-inch crusher run, chips, and weeper stone for septic tanks.

Brundige Construction Company (18)

NEW DUBLIN QUARRY

The New Dublin quarry of Brundige Construction Company is 1½ miles south of New Dublin on the west side of the road in lot 22, concession VI, Elizabethtown Township, Leeds County. The quarry is described by Hewitt (1964, p.23).

In the quarry face 27 feet of Beekmantown Dolomite (March Formation) are exposed. One and a half feet of light grey, silty, aphanitic, buff weathering dolomite at the base is overlain by 25.5 feet of medium to dark brown, medium to fine crystalline, medium- to thick-bedded dolomite. The brown dolomite has pink calcite patches at elevations from 4 to 5, 7½ to 10, and 14.5 to 16 feet above the floor of the quarry. Green glauconitic shaly parting is prominent at elevations between 6 and 7 and 16 and 17 feet above the floor. Weathered dolomite in the floor of the quarry shows colour banding in buff and dark grey.

The quarry is operated on demand. It was found to be inactive in July 1969 and August 1971.

Dibblee Construction Company Limited (40)

BOYCE QUARRY

The Boyce quarry, otherwise referred to as the South Gloucester quarry of Dibblee Construction Company is described by Hewitt (1964, p.27). Located in lot 25, concession V, Gloucester Township, just south of the quarry of Armstrong Brothers Company, the same section of Beekmantown Dolomite is quarried. The quarry is operated in two lifts, respectively 20 and 23 feet high. Due to a southerly dip of the beds, 37.6 feet of section could be measured in the 20-foot upper lift. A description is given in Table 17.

Chemical analyses of chip samples of the quarry face representing the lower lift and of a sample of 2-inch crushed stone representing the upper lift are given in Table 18.

QUARRY OPERATION

Quarrying and crushing are carried out with portable equipment in the spring of each year. HL3, 4, and 6, and screenings are produced. Asphalt sand is obtained elsewhere. A Barber Greene, Model 898, asphalt plant with a 6,000-pound batch capacity producing 185 tons of asphalt per hour is permanently installed in the quarry. The smoke stack is provided with a wet dust collector.

Fetterly's Quarry (49)

IROQUOIS

The Iroquois quarry, now operated by Fetterley's Quarry Division is described by Hewitt (1960, p.20-24). The quarry is on lots 30 and 31, concession I, Matilda Township, Dundas County, on the north side of Highway 2, west of Iroquois.

The quarry is operated on contract by Menard Construction Limited of Green Valley, Ontario. Recent production is obtained from the upper 24 feet

Table 17 — QUARRY SECTION — BOYCE QUARRY, DIBBLEE CONSTRUCTION COMPANY LIMITED, SOUTH GLOUCESTER

UNIT	DESCRIPTION	THICKNESS FEET
Oxford Formation		
Upper Lift		
DB3	Dolomite: medium grey, grey to brown weathering; fine crystalline to aphanitic; thin to medium bedded; in places laminated; shaly partings; minor gypsum in shale; 0.2 feet black shale at base	16.1
DB2	Dolomite: medium to light grey, grey or brown weathering; fine crystalline; medium to thick bedded; calcite crystals; irregular erosion surface and 0.2 feet shale at 14 feet; from 9 to 14 feet thick-bedded, siliceous dolomite including one bed of irregular thickness with abundant calcite crystals	21.5
Lower Lift		
DB1	Dolomite: medium to dark brownish grey, grey to brownish grey weathering; aphanitic to fine crystalline; medium to massive bedded; minor black shaly parting; rarely sandy; calcite crystals; dark grey, thin bedded and argillaceous from 8.5 to 9.6 feet	22.8
	Total	60.4

Table 18 — CHEMICAL ANALYSES — BOYCE QUARRY, DIBBLEE CONSTRUCTION COMPANY LIMITED, SOUTH GLOUCESTER

FEET ABOVE FLOOR	COMPONENTS IN PERCENT										
	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	P_2O_5	SO_3	L.O.I.	TOTAL	CO_2	FREE SILICA
22.8–60.4	8.68	1.88	0.90	18.9	27.3	0.02	1.09	42.0	100.8	...	...
8.5–22.8	10.0	3.48	1.66	17.5	25.6	...	...	39.6	97.84	38.9	...
0 – 8.5	17.4	2.53	1.24	16.0	25.8	...	...	35.9	98.87	36.0	12.3

in the southeast corner of the quarry. The remaining part of the quarry is flooded and favoured locally as a swimming pool.

Portable equipment is used in the quarry operation. A Cedarapids primary crusher in sequence with a Cedarapids Commander crushing and screening plant are fed by a 2½-cubic yard Caterpillar front-end loader. A bulldozer is available for maintenance.

The bulk of production is Granular 'A'; concrete- and asphalt-aggregate are produced as well.

Permanent Concrete Limited (83)

BROCKVILLE QUARRY

The quarry on lot 4, concession I, Elizabethtown Township is described by Hewitt (1964, p.24-25; 1960, p.19-20). The name of the company operating this quarry was shortened to Permanent Concrete Limited.

A section of 25 to 30 feet of Beekmantown Dolomite, including the upper and lower lifts of the previous description (Hewitt 1964) has been mined until recently. In 1971 quarrying took place in a 20-foot section below the floor of the previous quarry. Medium grey, medium to massive bedded, and in a few places sandy dolomites are exposed. The section is described in Table 19.

Chemical analyses of chip samples of the quarry face are given in Table 20.

QUARRY OPERATION

Drilling and blasting in the quarry is contracted by Armac Drillers Limited of Ottawa. Four 15-ton Euclid trucks are available for hauling stone.

The trucks are loaded at the face by a Northwest, Model 6, 1½-cubic yard shovel. Stone is fed to a Parker primary crusher with a 32- by 40-inch jaw via a Cedarapids vibrating feeder with grizzly. Crushed rock is scalped on a Jeffrey vibrator. Throughs go to a Nordberg standard cone crusher and are screened on two 3-deck screens. Oversizes

Table 19 | QUARRY SECTION – PERMANENT CONCRETE LIMITED, BROCKVILLE QUARRY

UNIT	DESCRIPTION	THICKNESS FEET
Beekmantown Dolomite		
Lower Lift	Dolomite: medium grey, massive to medium bedded; medium to fine crystalline; in places fine colour lamination; pink calcite crystals; buff weathering bed at base; 0.1 foot of rusty weathering buff, shaly dolomite at lower contact	7.6
	Dolomite: medium grey to medium dark grey, medium to thick bedded, fine crystalline to aphanitic; in places colour lamination	3.0
	Dolomite: medium grey, medium to thick bedded, medium crystalline to aphanitic; sandy; rusty weathering at upper contact	8.8
	Total	19.4

Table 20 | CHEMICAL ANALYSES – PERMANENT CONCRETE LIMITED, BROCKVILLE QUARRY

FEET ABOVE FLOOR	COMPONENTS IN PERCENT								
	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	L.O.I.	TOTAL	CO_2	FREE SILICA
8.8–19.4	17.7	1.15	2.17	14.4	25.9	36.4	97.72	35.4	12.4
0 – 8.8	38.4	3.28	2.12	9.26	19.4	25.5	97.96	25.1	32.4

as well as scalping from the vibrator are crushed in a small Parker crusher and screened on a double-deck Dillon screen.

A major part of production is sold commercially as Granular 'A' and 'B' and almost half is consumed in pre-mixed concrete and asphalt batches prepared on the property. This asphalt batching plant, a Cedarapids permanent plant with a capacity of 3,000 pounds per batch, has been fitted with a wet dust collector. Water is drawn from the quarry sump at a rate of 150 gallons per minute.

Two Caterpillar front-end loaders and a bulldozer are available for work on stockpiles and general maintenance.

Simcoe Limestone (Trenton-Black River)

Limestones of Trenton and Black River age occur in two main areas in Southern Ontario: the Georgian Bay-Lake Ontario area and the Ottawa-St. Lawrence Basin.

GEORGIAN BAY-LAKE ONTARIO AREA

The limestones of Trenton-Black River age outcrop in a wide belt south of a line extending from Mildand, on Georgian Bay, eastward across the northern end of Lake Simcoe, through Bobcaygeon and Madoc, to Kingston on Lake Ontario. These limestones have been termed 'Simcoe Group' by Liberty (1955; 1969) and have been subdivided on a lithostratigraphic basis into four formations as follows:

Simcoe Group
- Lindsay Formation
- Verulam Formation
- Bobcaygeon Formation
- Gull River Formation

The limestone of the Simcoe Group have a thickness of 600 to 750 feet. The Gull River Formation, which is the basal unit of the Simcoe Group, is underlain by the Shadow Lake Formation that consists of up to 40 feet of basal clastics, mainly greyish green calcareous arkose and red and green arenaceous shale.

The Trenton-Black River rock classification is given in Table 21. A comparison is given of the rock classification used in this report with that used previously by the author (Hewitt 1960; 1964). The new lithostratigraphic subdivision of Liberty (1969) is now used in the Georgian Bay-Lake Ontario area. The older classification of Wilson (1946) is used in the Ottawa-St. Lawrence Basin.

Table 21 TRENTON – BLACK RIVER ROCK CLASSIFICATION

	TIME-ROCK UNITS	G. M. KAY (1937)	B. V. SANFORD (1960)	D. F. HEWITT (1960)	B.A. LIBERTY (1969) Used in present report	
TRENTON	Cobourg	Cobourg: Hillier	Cobourg	Upper Trenton	SIMCOE GROUP	Lindsay
		Cobourg: Upper Hallowell				
		Cobourg: Lower Hallowell	Sherman Fall	Middle Trenton		Verulam U / L
	Sherman Fall	Sherman Fall				
	Hull	Hull (Kirkfield)	Kirkfield	Lower Trenton		Bobcaygeon U / M / L
	Rockland	Rockland				
BLACK RIVER	Leray		Coboconk	Upper Black River		
	Lowville	Chaumont	Gull River	Middle Black River		Gull River U / M
		Lowville				
	Pamelia	Pamelia		Lower Black River		Gull River L
			Shadow Lake	Basal Clastics		Shadow Lake

Shadow Lake Formation

Below the base of the Simcoe Group limestones where the Middle Ordovician sedimentary rocks rest directly on the Precambrian basement, there is commonly a few inches to several feet of basal clastics composed of conglomerate, grit, arkose, sandstone and red and green shale. Thicknesses of up to 40 feet are reported by Liberty (1969). In southern Ontario the Shadow Lake Formation has also been called the Rideau Beds. These basal clastics are not exposed in any operating commercial stone quarries in Ontario, but are well exposed at the Marmoraton pit at Marmora.

Simcoe Group

Gull River Formation

The Gull River Formation of Liberty (1969) consists of the Lowville and part of the Pamelia time-rock units. It includes part of the Pamelia, the Lowville, and the Chaumont of Kay (1937) and the Lower and Middle Black River of Hewitt (1960). A complete description may be found in Liberty (1969). Several commercial quarry operations are in this formation (see Map 2264, back pocket).

Bobcaygeon Formation

The Bobcaygeon Formation of Liberty (1969) consists of the Leray, Rockland, and Hull time-rock units. It includes the Rockland and Hull of Kay (1937) and the Coboconk and Kirkfield of Sanford (1961). It includes the Upper Black River and Lower Trenton of Hewitt (1960).

Verulam Formation

The Verulam Formation of Liberty (1969) consists of the Sherman Fall and lower part of the Cobourg time-rock units. It includes the Sherman Fall and Lower Hallowell Member of the Cobourg Formation of Kay (1937). It includes the Sherman Fall of Sanford (1961) and the Middle Trenton of Hewitt (1960).

Lindsay Formation

The Lindsay Formation of Liberty (1969) consists of the upper part of the Cobourg time-rock unit, the Upper Hallowell and Hillier Members of the Cobourg of Kay (1937), the Cobourg of Sanford (1961), and the Upper Trenton of Hewitt (1960).

Ottawa-St. Lawrence Basin

The subdivision of the Trenton and Black River limestones of the Ottawa-St. Lawrence Basin into members of the Simcoe Group has not been completed and the nomenclature of Wilson (1946) is used in this area. The Trenton and Black River Limestones are represented by a single formation, the Ottawa Formation.

W. B. Bennett Paving and Materials Limited (7)

COLLINS BAY

The Collins Bay quarry, now operated by W. B. Bennett Paving and Materials Limited, is located 1 mile east of Collins Bay on the south side of Highway 33. The quarry is described by Hewitt (1964, p.35), under Municipal Sand and Gravel.

In June 1969 the quarry had been deepened by 27 feet. This part of the section is described in Table 22. The limestones can be assigned to Member A of the Gull River Formation, according to Liberty (1971).

Chemical analyses of chip samples of sections of the quarry face are given in Table 23.

QUARRY OPERATION

Drilling, blasting, crushing, and screening are carried out on contract. A company-owned 2½-cubic yard, Model 944, Caterpillar front-end loader is on the property.

Bertrand and Frere Construction Company Limited (8)

L'ORIGNAL QUARRY

Operations in the L'Orignal quarry as described by Hewitt (1960, p.80) still continue. A pre-mixed concrete plant has been added for which sand is brought in from Papineauville. Deepening of the quarry is imminent.

Table 22 — QUARRY SECTION — W. B. BENNETT PAVING AND MATERIALS LIMITED, COLLINS BAY QUARRY

UNIT	DESCRIPTION	THICKNESS FEET
Gull River Formation, Member A		
Lower Lift		
CB2	Limestone and Dolomite: Limestone; medium to brownish grey; medium crystalline to aphanitic; thin to medium bedded; clastic; coquinoid calcarenite in part; shaly partings; Dolomite; medium grey to medium light grey or greyish green; medium crystalline to aphanitic; thick to medium bedded; in part laminated with abundant shaly partings; silty beds; clastic beds; calcirudite; calcite crystals	13.9
CB1	Limestone: dolomitic; medium grey to medium brownish grey; medium to microcrystalline, predominantly lithographic; thick bedded, partly laminated; minor shaly partings	13.2
	Total	27.1

Table 23 — CHEMICAL ANALYSES — W. B. BENNETT PAVING AND MATERIALS LIMITED, COLLINS BAY QUARRY, LOWER LIFT

FEET ABOVE FLOOR	COMPONENTS IN PERCENT								
	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	P_2O_5	SO_3	L.O.I.	TOTAL
12.2–27.1	23.2	3.90	1.36	3.89	34.2	0.05	1.71	31.0	99.3
2 –12.2	9.04	2.22	0.72	2.24	46.1	0.03	0.28	38.6	99.2

The company has recently opened a second quarry on the same limestone plain, approximately 1½ miles north of the L'Orignal quarry. Here an 18-foot face is worked for the production of 2-inch crusher-run stone for road construction in the area. The limestone is medium grey, medium to fine crystalline, variably thick- to thin-, but predominantly medium-bedded with black shaly partings and, in a few places, irregular shaly films. It is similar to limestone exposed in the previously described L'Orignal quarry and assigned to the Black River Formation. Beds are dipping 3 degrees to the southeast causing steps in the essentially horizontal surface. There is less than 1 foot of overburden.

Chemical analyses of samples of crushed rock from stockpiles in both quarries are given in Table 24.

QUARRY OPERATION

A Gardner-Denver Air Trac drill with 3-inch bit is used in both quarries.

Crushing in the new quarry is done by portable Pioneer and Diamond Commander crushers. A 2½-cubic yard front-end loader feeds the crusher from the face.

Table 24 — CHEMICAL ANALYSES – BERTRAND AND FRERE CONSTRUCTION COMPANY LIMITED, L'ORIGNAL QUARRY

	COMPONENTS IN PERCENT								
	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	P_2O_5	SO_3	L.O.I.	TOTAL
Main Quarry									
¾-inch crushed stone	4.33	0.47	0.20	1.10	51.4	0.11	0.21	42.0	99.8
North Quarry									
2-inch crusher run	22.1	4.50	1.64	3.11	35.3	0.12	1.81	30.6	99.2

Blair Construction Company (10)

ST. ALBERT STATION

A quarry is operated ½ mile west of St. Albert Station in lots 7 and 8, concession XII, Finch Township, Stormont County, by Blair Construction Company.

The old quarry of Silvertone Black Marble Company is on the property (Hewitt 1964, p.41). In August 1971 the quarry was operated on demand. Stockpiles are built up twice a year with a portable Cedarapids crushing and screening plant.

An 18-foot face of Upper Black River Limestone is quarried. The limestone is medium grey to dark grey or black, fine crystalline to microcrystalline, medium- to thick-bedded calcarenite to calcilutite with minor black shaly partings.

A chemical analysis of a sample of ½-inch crushed stone from the stockpile is given in Table 25.

QUARRY OPERATION

An Ingersoll-Rand wagon drill is used to drill 3-inch holes in a 7- by 8-foot pattern. After blasting the rock is loaded directly from the face by a Bucyrus Erie, Model 61, ¾-cubic yard shovel into a crusher feeder bin. The primary crusher is a Cedarapids jaw crusher. Rock proceeds to a secondary Cedarapids Commander jaw and roll crusher and is screened over two 2-deck screens. Sizes from 2½-inch crushed stone down can be produced but minus ⅞-inch stone is the major product.

The portable plant is equipped with a surge bin and loading belt. Two tandem trucks deliver material in the area. A Hough payloader and an International bulldozer are available for stockpile maintenance and clean-up work.

Table 25 — CHEMICAL ANALYSIS – BLAIR CONSTRUCTION COMPANY, ST. ALBERT STATION

COMPONENTS IN PERCENT								
SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	P_2O_5	SO_3	L.O.I.	TOTAL
2.46	0.66	0.44	1.37	52.5	0.02	0.53	42.3	100.3

M. Campbell Quarry (20)

SEBRIGHT

A quarry 2 miles west of Sebright just north of the road to Rathburn (Hewitt 1964, p.28) is operated by M. Campbell. Light brown to brownish grey, lithographic limestone, overlain by brownish grey, fossiliferous calcarenite is exposed in the 16-foot quarry face. The section is described in Table 26.

The lithographic limestone belongs to the Upper Member of the Gull River Formation (Liberty 1969) and is overlain by Lower Bobcaygeon calcarenite in the quarry section. The contact is equivalent to the contact between Middle and Upper Black River. The quarry is rarely operated.

Table 26 | QUARRY SECTION – M. CAMPBELL QUARRY, SEBRIGHT

UNIT	DESCRIPTION	THICKNESS FEET
Bobcaygeon Formation		
C2	Limestone: light to medium brown; medium- to thin-bedded calcarenite; shaly partings; fossiliferous: crinoids; brachiopods	7.2
Gull River Formation		
C1	Limestone: light brown to grey, weathering light to brownish or bluish grey; lithographic; thin to medium bedded; shaly partings; prominent shale from 5.5 to 5.6 feet and from 7.9 to 8.3 feet; calcite crystals and calcite filled fossil cavities near top	9.3
	Total	16.5

Canada Cement Lafarge Limited (21)

BELLEVILLE PLANT

The Belleville plant and quarry of Canada Cement Lafarge Limited are described by Hewitt (1960, p.57-61).

Carter Construction Company (26)

SWITZERVILLE

The quarry near Switzerville on lot 10, cencession VI, Ernestown Township, Lennox and Addington County, was quarried by Carter Construction Company (Hewitt 1964, p.33). The quarry has not been active since completion of Highway 401.

Above the water level in the quarry 20 feet of thin- to medium-bedded, medium grey Gull River Limestone was examined. The section, measured on the north face of the quarry, is described in Table 27.

A chemical analysis of a chip sample of the exposed 20 feet of the quarry face is given in Table 28.

Table 27 | QUARRY SECTION – CARTER CONSTRUCTION COMPANY

UNIT	DESCRIPTION	THICKNESS FEET
Gull River Formation		
CS1	Limestone: medium grey, light grey weathering; aphanitic to fine crystalline; thin to medium bedded; shaly partings; calcarenite-calcilutite; fossiliferous calcirudite from 11.3 to 12.3 feet	20

Table 28 | CHEMICAL ANALYSIS – CARTER CONSTRUCTION COMPANY

COMPONENTS IN PERCENT								
SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	P_2O_5	SO_3	L.O.I.	TOTAL
4.76	1.30	0.74	1.60	50.6	0.03	0.53	41.0	100.6

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Photo 1–Quarry face with township road in background, Clarence Township Quarry; July 1969.

Clarence Township Quarry (28)

A quarry operated by Clarence Township is described by Hewitt (1964, p.40). A section of Trenton Limestone ranging from 43 to 58 feet in height, is quarried.

Drilling is done by a Bucyrus Erie electric drill with a 6-inch bit.

A Dominion, Model 425, 1¼-cubic yard shovel, and a Case, 2-cubic yard front-end loader, are on the property. Crushing and screening is done in a permanent Cedarapids plant with a hammer crusher (36- by 41-inch) and screens for various sizes of aggregate.

Some agricultural lime is produced and sold to farmers in the area. Crushing for this purpose is done in an additional Cedarapids Hammermill installed in sequence with the crusher plant.

Commercial Crushed Stone Limited (29)

BILOW QUARRY

The Bilow Quarry (Hewitt 1964, p.36), located in lot 29, concession IV, Kingston Township, Frontenac County, north of Macadoo's Lane on the northern outskirts of Kingston, is presently operated by Commercial Crushed Stone.

The quarry is operated with a portable Cedarapids crushing and screening plant and is active on demand. A section of 30.7 feet of Gull River Limestone is exposed in different quarry faces in the uneven bedrock surface of the property. The limestone

is predominantly alternating medium grey and medium brownish grey calcarenite to calcilutite with, in part, abundant shaly partings.

A lower part of the section on the west side of the property shows development of ellipsoidal concretions or stromatolites in a fine- to microcrystalline, thin-bedded to laminated calcilutite.

The concretions are up to 1½ feet high with a corresponding 2½-foot diameter. They are also fine- to microcrystalline. Their light grey weathered surface stands out against the surrounding shaly limestone. A complete quarry section is described in Table 29.

Chemical analyses of chip samples of the quarry face are given in Table 30.

Table 29 QUARRY SECTION – COMMERCIAL CRUSHED STONE, BILOW QUARRY, MACADOO'S LANE

UNIT	DESCRIPTION	THICKNESS FEET
Gull River Formation Members C and D		
BM3	Limestone: dolomitic in part; medium brownish grey to medium dark grey, grey to buff weathering; medium to microcrystalline, fossiliferous calcarenite; thick to thin bedded, laminated in part; shaly partings; cross-laminations from 26.8 to 27.6 feet; calcirudite from 26.4 to 26.8 feet, minor calcite-filled vugs near base	15.3
BM2	Limestone and Shale: Limestone; medium to brownish grey, buff weathering; fine to microcrystalline; thin-bedded to laminated calcilutite; light grey weathering; ellipsoidal, fine- to microcrystalline calcilutite concretions of maximum 2½ feet diameter and 1½ feet high at 12.5 feet; shaly partings where concretions are absent; Shale; dark grey; fissile	4.4
BM1	Limestone: medium grey, light grey weathering; medium- to micro-, predominantly fine-crystalline; medium to thin bedded; shaly partings; calcite crystals; calcarenite-calcilutite beds	11.0
	Total	30.7

Table 30 CHEMICAL ANALYSES – COMMERCIAL CRUSHED STONE, BILOW QUARRY, MACADOO'S LANE

FEET ABOVE FLOOR	COMPONENTS IN PERCENT								
	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	P_2O_5	SO_3	L.O.I.	TOTAL
15.4–30.7	3.44	0.88	0.34	1.35	51.8	0.03	0.17	42.5	100.5
0 –15.4	8.20	2.16	0.88	2.24	46.1	0.04	0.64	38.7	99.0

A. G. Cook Limited (31)

WAUBAUSHENE QUARRY

A quarry is operated by A. G. Cook on lot 9 or 10, concession XIV, Tay Township, Simcoe County, approximately 3 miles northeast of Waubaushene.

The quarry is located in an outlier of Gull River Limestone on the Precambrian Shield. The beds are near horizontal and weakly undulating. One to two feet of overburden covers the even bedrock surface.

A 27-foot section is quarried in two lifts. The lower 11-foot lift is predominantly light brownish grey, arenaceous dolomitic limestone. A light grey, green-weathering dolomite bed forms the floor of the upper lift. The upper lift consists of light brown to brownish grey, aphanitic limestone, in many places mottled or with colour banding. Glauconite coating on fossils is common. The complete section together with information from a bore hole in the quarry floor is described in Table 31.

Chemical analyses of samples of 2-inch crushed stone representing each lift are given in Table 32.

Table 31 | QUARRY SECTION — A. G. COOK LIMITED, WAUBAUSHENE QUARRY, MACADOO'S LANE

UNIT	DESCRIPTION	THICKNESS FEET
(a)		
Gull River Formation Member A		
CW4	Limestone: light brown to dark brownish grey; aphanitic; thin to thick bedded; mottled or with colour lamination or banding; shaly partings; fossiliferous, glauconitic, and pyritiferous near top	15.3
	Upper Lift	15.3
CW3	Limestone: dolomitic; light grey to light brownish grey, buff to greenish weathering; green clastic beds near top; fine crystalline to lithographic; medium to thick bedded; laminated in part; minor calcite crystals; minor shaly partings; silty to sandy in part	9.9
CW2	Limestone: light brownish grey; medium crystalline to aphanitic; thick bedded; colour lamination; minor irregular shaly films; calcirudite included	1.5
	Lower Lift	11.4
(b)		
	Drill hole collared in floor of Lower Lift:	
CW2	As in quarry section	4.6
Shadow Lake Formation		
CW1	Shale: Siltstone, Sandstone, and Dolomite: Shale; dark to greenish grey; fissile 3 feet (from –12.4 feet to –11.7 feet; –13.8 feet to –13.3 feet; –20.6 feet to –18.8 feet); Siltstone; light grey to light olive green; calcareous; laminated; shaly partings 14.8 feet (from –11.7 feet to –4.6 feet; –13.3 feet to –12.4 feet; –18.8 feet to –15 feet; –23.6 feet to –20.6 feet); Sandstone; light to greenish grey; calcareous; fragments of granite gneiss included near contact 4.4 feet (from –28 feet to –23.6 feet); Dolomite; light grey; aphanitic; laminated 1.2 feet (from –15 feet to –13.8 feet)	23.4
	Red granite gneiss	2.0
	Depth of Hole	30.0

Table 32 | CHEMICAL ANALYSES — A. G. COOK LIMITED, WAUBAUSHENE QUARRY

	COMPONENTS IN PERCENT								
	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	P_2O_5	SO_3	L.O.I.	TOTAL
Upper Lift	4.53	1.06	0.49	4.02	48.4	0.04	0.30	41.6	100.4
Lower Lift	5.78	1.18	0.86	7.21	43.2	0.05	0.57	41.3	100.2

QUARRY OPERATION

A Joy Air Trac drill with 1¾-inch bit is used for drilling of the quarry face. A Linkbelt, Model 360, 1½-cubic yard shovel is used for loading. Three 22-ton Euclid trucks haul stone to the primary crusher, a 36- by 45-inch Cedarapids double-impeller impact crusher, equipped with feeder bin and vibrating grizzly. Changes to be carried out for future production include transfer of primary crushing equipment to the bottom of the quarry. Loading at the face will be done by 6-cubic yard front-end loader. Hydro-electric power will replace the power generators presently used.

Secondary crushing and screening is carried out in a portable plant with two 4-foot Telsmith, Model 48S, standard gyratory crushers and two double-deck Telsmith screens, measuring respectively 5 by 16 feet and 4 by 10 feet. Stone is stockpiled by stacker conveyors. Two bins with loading belts and a 3½-cubic yard Euclid front-end loader are available for loading trucks. A weigh scale with 55-ton capacity is installed at the entrance of the 200-acre property.

Cornwall Gravel Company (34)

MacLEOD QUARRY

The MacLeod quarry of Cornwall Gravel Company is in lot 4, concession IV, Cornwall Township, Stormont County, about 1½ miles east of Eamer. The quarry is operated in three lifts with a total depth of 60 feet. The section is described in Table 33.

Chemical analyses of chip samples of the face of the quarry are given in Table 34.

Table 33 QUARRY SECTION – CORNWALL GRAVEL COMPANY, MacLEOD QUARRY, CORNWALL

UNIT	DESCRIPTION	THICKNESS FEET
Middle Black River Formation		
CC3	Limestone: medium grey, grey weathering; medium crystalline to aphanitic; thick to massive bedded; thin-bedded zone from 49.3 to 54.8 feet, alternating calcarenite and calcilutite; calcite crystals; shaly partings; 0.3 feet shaly limestone at 40.5 feet	25.1
CC2	Limestone: medium brownish grey; medium crystalline to aphanitic; thick to thin bedded; calcite crystals	7.1
Lower Black River Formation		
CC1	Limestone and Dolomite: Limestone; partly dolomitic; medium to dark grey; medium crystalline to aphanitic, in a few places lithographic; medium to thin bedded, in a few places laminated; shaly partings; minor calcite crystals; Dolomite; light greenish grey; medium crystalline to aphanitic; thick bedded; green bed marks top of Lower Black River	27.6
	Total	59.8

Table 34 CHEMICAL ANALYSES – CORNWALL GRAVEL COMPANY, MacLEOD QUARRY, CORNWALL

FEET ABOVE FLOOR	COMPONENTS IN PERCENT								
	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	P_2O_5	SO_3	L.O.I.	TOTAL
33.7–59.8	5.63	1.75	0.72	1.10	49.3	0.01	0.98	39.9	99.4
17.9–33.7	9.33	2.12	1.02	1.52	46.6	0.02	0.98	38.0	99.6
3.1–17.9	15.0	3.25	1.13	3.70	40.0	0.02	0.43	35.4	98.9

QUARRY OPERATION

Loading of broken stone at the quarry face is done by an Osgood 1½-cubic yard shovel. Two 22-ton Euclid trucks haul rock to a permanent 43- by 50-inch Cedarapids double-impellor primary crusher. Products are screened on a double-deck, 4- by 14-foot screen.

The oversize is crushed by a 4-foot Pulvermatic cone crusher and subsequently screened on a 4- by 12-foot double-deck screen.

Various sizes of aggregate for road construction, asphalt, and concrete are produced. Two 18-ton Euclid trucks haul rock from a surge bin at the crushing and screening plant to a permanent Barber-Greene asphalt batching plant on the property and to a company owned pre-mixed concrete plant in Cornwall. Two 2½-cubic yard Caterpillar front-end loaders are available for loading at the stockpiles. A weigh scale with a maximum capacity of 50 tons is installed at the gate.

Cruickshank Construction Limited (35)

WILLIAMSBURG

A quarry 2¼ miles northwest of Williamsburg, on lot 31, concession VII, Williamsburgh Township, Dundas County, is operated by Cruickshank Construction. Lower Black River limestone and dolomite

Table 35 | QUARRY SECTION – CRUICKSHANK QUARRY, WILLIAMSBURG

UNIT	DESCRIPTION	THICKNESS FEET
Lower Black River Formation		
CW3	Limestone: medium grey, buff weathering; fine crystalline; medium to thick bedded; shaly parting	3.2
CW2	Dolomite and Limestone: Dolomite; light greenish grey, buff weathering; aphanitic; thick to massive bedded; Limestone; medium grey; fine to microcrystalline; medium bedded; shaly parting	6.3
CW1	Limestone and Dolomite: Limestone; medium to dark brownish grey; fine crystalline to lithographic; medium bedded; shaly parting; Dolomite; light to medium greenish grey; aphanitic; medium bedded	10.5
	Total	20.0

Table 36 | CHEMICAL ANALYSIS – CRUICKSHANK QUARRY, WILLIAMSBURG

COMPONENTS IN PERCENT								
SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	P_2O_5	SO_3	L.O.I.	TOTAL
19.6	3.75	1.27	6.51	33.0	0.04	0.90	33.3	98.4

are quarried. Locally beds are dipping 4 degrees to the east.

A 20-foot section, measured on the south face, is described in Table 35.

A chemical analysis of a sample of 1-inch crushed stone from the stockpile is given in Table 36.

QUARRY OPERATION

The quarry is operated on demand. Drilling, blasting, crushing, and screening are contracted out. A front-end loader is available for work on stockpiles. Products include 1¼-inch, ¾-inch, and ⅝-inch crushed stone and asphalt aggregate for township and county roads.

J. C. Denison Quarry (37)

NAPANEE

A quarry was opened in 1969 on lot 21, concession VII, North Fredericksburgh Township, Lennox and Addington County, 1 mile northeast of Napanee. The quarry is adjacent to McFarland's Quarry described by Hewitt (1964, p.33). Access has been obtained by extending the upper lift of McFarland's Quarry eastward across the town boundary.

GEOLOGY

A section of 14.6 feet of Gull River Limestone is exposed in the eastern face of McFarland's Quarry. It is described in Table 37.

Table 37 | QUARRY SECTION – DENISON QUARRY, NAPANEE

UNIT	DESCRIPTION	THICKNESS FEET
Gull River Formation Member D		
DN3	Limestone: dark grey; fine crystalline; thin bedded; shaly partings; 0.3 feet shale included	5.0
DN2	Shale: dark grey, medium grey weathering; calcareous	2.4
DN1	Limestone: medium brownish grey; fine crystalline to aphanitic; medium bedded; shaly partings	7.2
	Total	14.6

Table 38 | CHEMICAL ANALYSIS – DENISON QUARRY, NAPANEE

COMPONENTS IN PERCENT								
SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	P_2O_5	SO_3	L.O.I.	TOTAL
3.44	0.76	0.40	0.60	52.4	0.04	0.48	42.0	100.1

A chemical analysis of a sample of ¾-inch crushed stone from the stockpile is given in Table 38.

A second lift in McFarland's Quarry extending into Member C of the Gull River Formation is partly flooded. Seven feet of medium grey to medium dark grey, fine to microcrystalline, thick- to thin-bedded calcarenite are exposed above the water line.

QUARRY OPERATION

A Gardner-Denver Air Trac drill with a 2½-inch bit serves to drill the face in a 6- by 9-foot pattern. Dynamite and prills are used for blasting.

A Northwest, Model 6, 1½-cubic yard shovel loads stone at the face. A Cedarapids portable crushing plant with a 22- by 36-inch primary jaw and a 10- by 36-inch secondary jaw crusher and 16- by 24-inch rolls, combined with an Assinck, 4- by 12-foot, double-deck screen is employed to produce Granular 'A' and 'B', and stone for weeping beds. Two Trojan 2-cubic yard front-end loaders and two Caterpillar, Model D8, bulldozers were available for loading and stripping at the time of visiting.

Dibblee Construction Company Limited (38)

CORNWALL QUARRY

The Cornwall quarry of Dibblee Construction Company has been deepened considerably since last reported on by Hewitt (1964, p.42). The section could not be measured completely due to flooding of the quarry but is estimated to be at least 75 feet. Stockpiles built up in 1968 are largely depleted.

The quarry was drained in the spring of 1971 and is expected to become active again. Some drilling and blasting took place, but no crushing was undertaken up until August 1971.

The quarry section is described in Table 39.

A chemical analysis of a chip sample of the lower part of the quarry face is given in Table 40.

Table 39 | QUARRY SECTION – DIBBLEE CONSTRUCTION COMPANY LIMITED, CORNWALL QUARRY

UNIT	DESCRIPTION	THICKNESS FEET
Lower and Middle Black River Limestone		
DC4	Limestone: medium grey; massive bedded; aphanitic to microcrystalline; fossiliferous	8.0
DC3	Limestone: dark grey; argillaceous; medium to thin bedded; aphanitic; black shaly partings; minor pyrite	4.8
DC2	Limestone: medium to dark grey; medium to thick bedded; fine to microcrystalline; black shaly parting; in places calcite-filled vugs	24.5
DC1	Limestone and Dolomite: Limestone; medium to dark grey; medium bedded; aphanitic to fine crystalline; shaly partings; Dolomite; light to greenish grey; siliceous; thick bedded; aphanitic to fine crystalline; buff weathering	17.1
	Depth to water Level	54.4

Table 40 | CHEMICAL ANALYSIS – DIBBLEE CONSTRUCTION COMPANY LIMITED, CORNWALL QUARRY

FEET ABOVE WATER LEVEL	COMPONENTS IN PERCENT								
	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	L.O.I.	TOTAL	CO_2	FREE SILICA
5.1–17.1	13.8	4.63	1.81	5.55	38.1	35.4	99.29	34.6	7.66

Table 41 | QUARRY SECTION — DIBBLEE CONSTRUCTION COMPANY LIMITED, WILLIAMSBURG QUARRY

UNIT	DESCRIPTION	THICKNESS FEET
Lower Black River Formation		
DW3	Limestone: medium grey; buff weathering; medium crystalline; medium bedded; fossiliferous calcarenite	1.0
DW2	Dolomite: light greenish grey; buff weathering; silty	1.2
DW1	Limestone: dolomitic; medium grey; medium crystalline to aphanitic; medium bedded; calcarenite-calcilutite	7.8
	Depth to water level	10.0

Table 42 | CHEMICAL ANALYSIS — DIBBLEE CONSTRUCTION COMPANY LIMITED, WILLIAMSBURG QUARRY

COMPONENTS IN PERCENT								
SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	P_2O_5	SO_3	L.O.I.	TOTAL
17.6	3.09	1.18	6.90	34.4	0.04	0.53	35.2	98.9

Dibblee Construction Company Limited (39)

FALLOWFIELD QUARRY

The Fallowfield quarry of Dibblee Construction Company, described by Hewitt (1964, p.39), is inactive.

Stockpiles of crushed rock on the property were used in 1971 in a small asphalt batching plant operated by Ottawa Valley Crushed Stone.

Dibblee Construction Company Limited (41)

WILLIAMSBURG QUARRY

A quarry has been opened on lot 33, concession VII, Williamsburgh Township, Dundas County, 2½ miles northwest of Williamsburg, by Dibblee Construction Company.

The quarry is flooded. Above the water level approximately 10 feet of Lower Black River Limestone is exposed in near horizontal beds. The section is described in Table 41.

A chemical analysis of a sample of ¾-inch crushed stone from the stockpile is given in Table 42.

Francon Limited (50)

OTTAWA

Quarry and plant of Francon Limited are described by Hewitt (1960, p.74-77) under the heading Ottawa Valley Crushed Stone Limited. A new quarry was opened on the same property, southwest of the previously described one. It went into production in July 1969.

GEOLOGY

The second quarry occurs just south of a minor northeast-southwest-running vertical fault. Beds are dipping approximately 5 degrees to the east. They have come down on the south side of the fault and are warped parallel to it locally. Quarrying exposed another vertical fault at the south face of the new quarry. It runs 20 degrees north of west, is about 1 foot wide and filled with gouge, gypsum, and calcite.

Limestone in the new quarry is grey to brownish grey, predominantly massive-bedded calcarenite belonging to the Middle Black River Formation. Coquinoid calcarenite and a few chert lenses are common near the top of the section. Due to dipping of the beds the section exposed in the 40-foot deep quarry is about 49 feet. It is described in Table 43.

Chemical analyses of chip samples of the quarry face and of an additional 25 feet of limestone exposed by stripping of the bedrock surface are given in Table 44.

QUARRY OPERATION

There is up to 20 feet of overburden covering the limestone. The bedrock surface is uneven; steps are formed by the east-dipping beds.

Table 43 | QUARRY SECTION – FRANCON QUARRY, OTTAWA

UNIT	DESCRIPTION	THICKNESS FEET
Middle Black River Limestone		
FO2	Limestone: medium to light grey, in places light brownish grey; medium crystalline to aphanitic; massive to medium bedded; minor chert lenses; fossiliferous calcarenite; brachiopods	29.0
FO1	Limestone: medium brownish to medium dark grey; fine crystalline to aphanitic; medium bedded; black shaly partings	20.0
	Total	49.0

Table 44 | CHEMICAL ANALYSES – FRANCON QUARRY, OTTAWA

	COMPONENTS IN PERCENT								
	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	P_2O_5	SO_3	L.O.I.	TOTAL
Surface rocks	9.04	0.44	0.32	0.98	48.8	0.10	0.30	39.8	99.8
FO2	6.05	0.62	0.33	1.60	50.4	0.10	0.34	40.8	100.2
FO1	7.13	1.59	0.70	1.51	49.0	0.12	0.78	39.8	100.6

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Photo 2–Black River Limestone exposed in south face of the newly opened quarry, Francon, Ottawa; July 1969.

Two drills, a Schramm and a Bucyrus-Erie, Model 40R, drill 6¼-inch and 6¾-inch holes respectively.

Loading of stone at the face is done by Bucyrus-Erie, Model 100B, 4-cubic yard shovel. A 2-cubic yard Dominion shovel is used for stripping.

Four 25-ton Mack trucks haul stone to the primary crusher, a 42- by 48-inch Hewitt-Robins jaw crusher. Secondary crushing is provided by a 4¼-foot Symons shorthead crusher. Plus 2-inch stone is scalped and recrushed in two 3-foot Symons cone crushers.

The crusher products go to the screenhouse for sizing and then to five storage bins. The main sizes produced are 2-inch, 1½-inch, ⅝-inch, ⅜-inch, and dust. The stone is stockpiled by truck. Haulage is entirely by truck. Two Caterpillar front-end loaders are available for work on stockpiles. The stone is mainly used for concrete and asphalt aggregate and road stone. Two asphalt batching plants operate on demand on the property.

Frazer Duntile Limited (51)

ORLEANS QUARRY

Frazer Duntile Limited operates a quarry in Middle Black River Limestone north of Highway 17 at Orleans. A description is given by Hewitt (1964, p.40).

A chemical analysis of a sample of 1-inch crushed stone from the stockpile is given in Table 45.

Table 45 — CHEMICAL ANALYSIS — FRAZER DUNTILE, ORLEANS QUARRY

COMPONENTS IN PERCENT								
SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	P_2O_5	SO_3	L.O.I.	TOTAL
6.24	1.56	0.60	1.37	49.3	0.02	0.78	40.2	100.1

QUARRY OPERATION

Drilling is done by Gardner-Denver Air Trac drill. Broken stone is loaded at the face by an Osgood, Model 1000, 2½-cubic yard shovel. A drop-ball breaks large blocks remaining after the blast. Two Caterpillar 2½-cubic yard front-end loaders are available on the property. Crushing and screening take place in a semi-permanent plant with a Cedarapids Impellor primary crusher and a 4-foot Symons Standard cone crusher.

The quarry produces concrete aggregate (⅜-inch and ⅝-inch), minus ⅞-inch and minus 1-inch stone for road construction.

Glen Lawrence Construction Company (52)

MACADOO'S LANE

On Macadoo's Lane, just east of Division Street and north of Highway 401 at Kingston, on lot 26, concession IV, Kingston Township, Frontenac County, a quarry is operated by Glen Lawrence Construction Company. The quarry is on the edge of an escarpment with an uneven bedrock surface. A 32.5-foot face was measured. Gull River Limestone, predominantly medium grey and medium brownish grey calcarenite to calcilutite, with in places abundant

Table 46 — QUARRY SECTION — GLEN LAWRENCE QUARRY, MACADOO'S LANE, KINGSTON

UNIT	DESCRIPTION	THICKNESS FEET
Gull River Formation Members C and D		
GL1	Limestone: partly dolomitic; medium grey to medium brownish grey; medium to microcrystalline; lithographic beds; thin to thick bedded; laminated in part; dark grey; thin bedded to fissile limestone with abundant shaly partings from 10.6 to 11.9 feet and from 19.1 to 19.8 feet; medium light grey bed with specks of secondary calcite from 18.1 to 18.6 feet; shaly partings; calcite crystals; minor pyrite at 10.5 feet; calcirudite from 25.9 to 26.6 feet	32.5

shaly partings, is quarried in one lift. The section is described in Table 46.

Chemical analyses of chip samples of the quarry face are given in Table 47.

QUARRY OPERATION

The quarry is operated on demand with a portable crushing and screening plant. Stockpiles of Granular 'A'- and 'B'-crushed stone are kept available for road construction. A 2-cubic yard Caterpillar front-end loader is used on the stockpiles.

Asphalt is made on the property in a Barber-Greene plant with a 2-ton batch capacity. However, aggregate for this purpose is brought in from a trap-rock quarry in Marmora.

Griffin Brothers Construction Company (54)

BATTERSEA QUARRY

A quarry on lot 5, concession VIII, Storrington Township, Frontenac County, approximately 2¼ miles southwest of Battersea, east of and adjacent to the highway to Sunbury, has been operated by Griffin Brothers Construction. The quarry is inactive. Fifteen feet of buff weathering dolomite and grey to brownish grey, lithographic limestone, ascribed to the Gull River Formation, Member A, are exposed in the quarry face. The section is described in Table 48.

Griffin Brothers Construction Company (55)

JOYCEVILLE QUARRY

A quarry is operated by Griffin Brothers Construction on lot 18, concession V, Pittsburgh Township, Frontenac County, ½ mile southwest of Joyceville.

A 22.5-foot section of limestone of the Gull River Formation, Member A, is quarried in one lift. The section is described in Table 49.

Chemical analyses of chip samples of the quarry face are given in Table 50.

At the time of visiting in June 1969 the quarry was inactive. It is operated with a portable crushing and screening plant.

Lake Ontario Cement Limited (61)

PICTON

The quarry and cement plant of Lake Ontario Cement, 2½ miles northeast of Picton, are described by Hewitt (1960, p.54-56; 1964, p.31-32).

The quarry north of the road has been deepened by 43 feet to a total average depth of 90 feet. The lower beds in the quarry section are characterized by alternating beds of shale and limestone that is typical of the Verulam Formation in the area. This

Table 47 CHEMICAL ANALYSES – GLEN LAWRENCE QUARRY, MACADOO'S LANE, KINGSTON

FEET ABOVE FLOOR	COMPONENTS IN PERCENT								
	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	P_2O_5	SO_3	L.O.I.	TOTAL
20–32.5	8.08	2.18	0.82	1.03	48.0	0.03	0.66	39.0	99.8
0–20	7.92	2.31	1.27	0.96	47.5	0.03	0.99	38.8	99.8

Table 48 QUARRY SECTION – GRIFFIN BROTHERS CONSTRUCTION COMPANY, BATTERSEA QUARRY

UNIT	DESCRIPTION	THICKNESS FEET
Gull River Formation Member A		
GB2	Dolomite: medium light grey, buff weathering; aphanitic; medium to thick bedded; shaly partings; calcite crystals; gypsum filling 6-inch vugs in upper bed	3.0
GB1	Limestone: dolomitic; medium grey to medium brownish grey, light grey to buff weathering; lithographic, in places fine crystalline; medium to thick bedded; shaly partings; stylolites in upper 2 feet; platy bedding near upper contact	11.7
	Total	14.7

Table 49 | QUARRY SECTION — GRIFFIN BROTHERS CONSTRUCTION COMPANY, JOYCEVILLE QUARRY

UNIT	DESCRIPTION	THICKNESS FEET
Gull River Formation Member A		
GJ3	Limestone: medium grey; fine crystalline to lithographic; medium to thin bedded; laminated; shaly partings; cross laminations; calcarenite-calcirudite bed included	5.5
GJ2	Dolomite: medium light grey, buff weathering; medium to fine crystalline; medium bedded; minor shaly partings; in places calcite crystals; green-mottled laminated beds with green shaly partings included; greenish grey, shaly dolomite at base	9.6
GJ1	Limestone: dark grey, brownish grey weathering; lithographic; in places medium crystalline, porous; medium bedded; calcite crystals, gypsum as vug fillings; minor shaly partings; some rusty weathering	7.4
	Total	22.5

Table 50 | CHEMICAL ANALYSES — GRIFFIN BROTHERS CONSTRUCTION COMPANY, JOYCEVILLE QUARRY

FEET ABOVE FLOOR	COMPONENTS IN PERCENT								
	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	P_2O_5	SO_3	L.O.I.	TOTAL
17.0–22.5	2.07	0.66	0.59	2.24	51.5	0.02	0.26	42.9	100.2
7.4–17.0	21.5	4.88	1.64	8.67	28.8	0.06	1.25	31.7	98.5
0 – 7.4	6.83	1.75	0.88	1.28	48.4	0.05	1.23	39.1	99.5

Table 51 | QUARRY SECTION — LAKE ONTARIO CEMENT QUARRY, PICTON

UNIT	DESCRIPTION	THICKNESS FEET
Lindsay Formation		
LO2	Limestone: medium grey; aphanitic to medium, predominantly fine crystalline; medium to thin bedded calcarenite; shaly partings	42–52
Verulam Formation		
LO1	Limestone: medium grey; aphanitic to medium, predominantly fine crystalline; medium to thin bedded calcarenite; abundant shaly parting; many 1-inch shaly interbeds; from 6.1 to 7.5 feet and from 11.2 to 12.4 feet very thin bedded; argillaceous limestone with prominent shaly interbeds	43.4

part of the section is quarried in a separate 30-foot lower lift.

Drill hole information supplied by the company indicates that pure, high Ca-limestone ($CaO > 45$ percent) is found to a depth of 52½ feet from the surface and from 165 feet down to the bottom of the drill hole at 253¼ feet. Between 52½ and 165 feet the limestone is less pure; high values are obtained in SiO_2 (maximum 16.70 percent), Al_2O_3 (maximum 5.72 percent), and Fe_2O_3 (maximum 1.96 percent), indicating the presence of shaly Verulam beds. The hole was drilled ⅓ mile northwest of the cement plant at an elevation of 331 feet.

The quarry section is described in Table 51.

QUARRY OPERATION

There has been one notable change in the quarry operation. Loading by shovel has been abandoned in favour of loading with front-end loaders. No other changes were reported at the time of visiting in July 1969.

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Photo 3–View of the Lake Ontario cement plant looking east from the new road north of Picton; October 1971.

Table 52 | QUARRY SECTION – LIMESTONE QUARRIES LIMITED, UHTHOFF QUARRY

UNIT	DESCRIPTION	THICKNESS FEET
Gull River Limestone Lower Lift		
UL3	Dolomite: light olive grey, greenish buff weathering; aphanitic to fine crystalline; thin to thick bedded; shaly partings; 0.15 feet green shale included	3.8
UL2	Limestone: dolomitic; light brown to grey, buff in upper part; aphanitic to lithographic; thick to massive bedded; minor thin bedded sections with shaly partings; mottled brown and light grey from 0 to 8.0 feet; irregular colour banding from 8.6 to 13 feet; greyish white chert (10 percent) between 13 and 15.8 feet; lithographic bed (2.2 feet) at 15.8 feet	23.5
	Lower Lift	27.3
UL1	Dolomite: sandy; light grey or buff to reddish brown; greyish green near top; shale at contact; fine crystalline; medium bedded; minor shaly partings; porous; calcite crystals; pyrite	5.9
	Total	33.2

Table 53 | CHEMICAL ANALYSES – LIMESTONE QUARRIES LIMITED, UHTHOFF QUARRY

FEET ABOVE FLOOR	COMPONENTS IN PERCENT								
	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	P_2O_5	SO_3	L.O.I.	TOTAL
18–27.3	8.94	1.78	0.76	12.5	34.9	0.04	0.24	40.5	99.7
0–18	4.02	0.62	0.33	3.85	49.0	0.03	0.27	42.4	100.5

Limestone Quarries Limited (63)

UHTHOFF

The quarry of Limestone Quarries Limited on lot 10, concession IV, Orillia Township, Simcoe County, is described by Hewitt (1960, p.31-33; 1964, p.28).

The quarry has been deepened by 27 feet in grey and brown aphanitic to lithographic and in places arenaceous Gull River Limestone. The section is described in Table 52.

Chemical analyses of chip samples of the quarry face are given in Table 53.

McCarthy Brothers Quarry (64)

GAMEBRIDGE

A quarry ½ mile northwest of Gamebridge, on lot 11, concession A, Mara Township, Ontario County, is operated by McCarthy Brothers. The quarry is in thin- to medium-bedded, brownish grey, shaly limestone of the Verulam Formation. The 35.4-foot quarry face cuts westward into a minor escarpment. The section is described in Table 54.

Chemical analyses of chip samples of the quarry face are given in Table 55.

The uneven bedrock surface is covered with less than 1 foot of overburden.

QUARRY OPERATION

Drilling of the face is carried out with a Thor wagon drill operated on compressed air. A Michigan, Model 175A, 2½-cubic yard front-end loader feeds stone to a portable primary Cedarapids impact crusher with grizzly. Crushed stone is screened on a 2-deck 4- by 14-foot screen. Three 30-inch stacker conveyor belts stockpile the screened product. The operation is seasonal. Products include Granular "A" and "B" for township road construction, filter stone for weeping beds, and stone for surface hardening of parking lots and driveways.

Table 54 | QUARRY SECTION – McCARTHY BROTHERS QUARRY, GAMEBRIDGE

UNIT	DESCRIPTION	THICKNESS FEET
Verulam Formation		
MB1	Limestone: argillaceous; abundant shaly partings; medium brownish grey; medium crystalline to aphanitic; thin to thick, predominantly medium bedded; fossiliferous calcarenite to calcirudite; abundant fossils crinoids, brachiopods, trilobites, bryozoa (Prasopora); thick bed with calcite crystals from 22 to 23.2 feet; nodular weathering beds near top of section	35.4

Table 55 | CHEMICAL ANALYSES – McCARTHY BROTHERS QUARRY, GAMEBRIDGE

FEET ABOVE FLOOR	COMPONENTS IN PERCENT								
	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	P_2O_5	SO_3	L.O.I.	TOTAL
18–35.4	15.2	3.34	1.37	1.28	42.1	0.08	0.88	35.3	99.5
1–18	17.2	4.56	1.72	2.09	39.0	0.11	1.28	33.3	99.3

H. J. McFarland Construction Company (65)

CONSECON QUARRY

A quarry 1.5 miles south of Consecon, on lot 107, concession IV, Hillier Township, Prince Edward County, just east of Highway 33, is operated on demand by H. J. McFarland Construction Company.

Bedrock surface and quarry floor are uneven. Up to 4 feet of overburden overlies the 23.2 feet of thin- to medium-bedded, brownish grey limestone of the Lindsay Formation exposed in the quarry face. The section is described in Table 56.

Chemical analyses of chip samples of the quarry face are given in Table 57.

H. J. McFarland Construction Company (66)

FALLOWFIELD QUARRY

The Fallowfield quarry of H. J. McFarland Construction Company is a mile northeast of Fallowfield on lot 23, concession V, Nepean Township, Carleton County. A description by Hewitt (1964, p.38) covers the upper 36 feet of the present quarry face. Deepening has exposed another 23.2 feet. A description is given in Table 58.

The limestone is quarried in two lifts. The upper 36 feet, consisting primarily of medium- to thin-bedded limestone with black shaly parting is quarried for granular base course for road construction. The lower 23.2 feet provide asphalt aggregate which is processed in an asphalt plant on the property. A vertical fault cuts through the northeast corner of the quarry.

QUARRY OPERATION

There is approximately 4 feet of overburden. The quarry face is worked in two lifts, an upper lift of 36 feet and a lower lift of 23 feet. Drilling is done on a 9- by 9-foot pattern by a Gardner-Denver Air Trac drill, drilling 2½-inch holes. Stone is loaded by a Dominion, Model 700, 4-cubic yard shovel or by one of two available 3½-cubic yard Michigan front-end loaders. Three 22-ton Euclid trucks are on haulage.

The primary crusher is a Lippman 30- by 42-inch jaw crusher. The product goes to a 1-inch grizzly that produces oversize and ¾-inch crusher run. The oversize goes to the secondary crusher, a Cedarapids impact breaker. The product goes to the screening plant that consists of four 4- by 14-foot 3-deck Cedarapids screens. The oversize from the top deck of the No. 1 screen is recrushed in a 4-foot Symons short head or a 4½-foot Symons standard cone crusher and returned to the screens. Products are ¾-inch crusher run, 1½-inch, 1-inch, ¾-inch ⅝-inch, ⅜-inch, and 3/16-inch stone. Plant capacity is approximately 400 tons per hour.

H. J. McFarland Construction Company (67)

KINGSTON QUARRY

South west of the intersection of Highways 401 and 38, on lot 9, concession IV, Kingston Township,

Table 56 | QUARRY SECTION – H. J. McFARLAND CONSTRUCTION COMPANY, CONSECON QUARRY

UNIT	DESCRIPTION	THICKNESS FEET
Lindsay Formation		
MC1	Limestone: medium brownish grey; light grey to brown weathering; medium crystalline to aphanitic; thin to medium bedded; fossiliferous, medium crystalline calcarenite beds and lenses in calcilutite; nodular weathering	23.2

Table 57 | CHEMICAL ANALYSES – H. J. McFARLAND CONSTRUCTION COMPANY, CONSECON QUARRY

FEET ABOVE FLOOR	COMPONENTS IN PERCENT								
	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	P_2O_5	SO_3	L.O.I.	TOTAL
17.2–23.2	11.8	2.90	1.03	1.28	44.8	0.06	0.23	37.1	99.2
11.2–17.2	9.79	2.50	0.93	1.48	45.9	0.07	0.47	38.0	99.1
0 –11.2	14.6	3.68	1.34	1.60	42.1	0.05	0.58	35.3	99.3

ODM8745

Photo 4–Fallowfield Quarry, H. J. McFarland Construction Company; August 1969.

Table 58 | QUARRY SECTION – H. J. McFARLAND CONSTRUCTION COMPANY, FALLOWFIELD QUARRY

UNIT	DESCRIPTION	THICKNESS FEET
Upper Lift		
Middle Black River Limestone		
MF6	Limestone: medium grey, light grey weathering; microcrystalline to aphanitic; medium to thin bedded; black shaly partings; calcilutite	20.0
Lower Black River Limestone		
MF5	Limestone: dolomitic; greyish green, greenish weathering; aphanitic; medium bedded; shaly partings; "green beds"	3.7
MF4	Limestone: medium grey, grey weathering; microcrystalline to aphanitic; thin to medium bedded; black shaly partings	12.0
	Upper Lift	35.7
Lower Lift		
MF3	Limestone: medium to dark grey, light grey weathering; medium crystalline to aphanitic; thick bedded; prominent 0.7-foot thin bedded, shaly horizon at 3.7 feet above contact; calcarenite to calcilutite; calcite filled vugs in upper 2 feet	6.4
MF2	Limestone: medium dark grey, light grey weathering; aphanitic; medium to thin bedded, thick bedded appearance in quarry face; minor shaly parting	11.8
MF1	Limestone: medium dark grey calcilutite; medium to massive bedded; calcite filled vugs	5.0
	Lower Lift	23.2
Sump	Limestone: dark grey calcilutite; medium to thin bedded; shaly parting	3.0

Frontenac County, a quarry is operated by H. J. McFarland Construction Company.

A 30.7-foot section of Gull River Limestone, Member D, is quarried in two lifts of 14 and 16.7 feet respectively. A 1.7-foot thick limestone bed in the 16.7-foot bottom lift forms a distinctive marker bed. The quarry section is described in Table 59.

A chemical analysis of a sample of 1-inch crushed stone from the stockpile is given in Table 60.

QUARRY OPERATION

The quarry is operated with portable crushing and screening equipment. Drilling of the face is done with an Air Trac drill with 3-inch bit. Stone is fed into the primary breaker, a Cedarapids double-impeller, by a 5-cubic yard Caterpillar front-end loader. The portable plant carries three 3-deck screens and rolls and a jaw crusher for secondary crushing.

At the time of visiting in September 1971 the quarry produced mainly ⅞-inch stone for road construction.

H. J. McFarland Construction Company (68)

MARYSVILLE QUARRY

A quarry has been opened by McFarland Construction Company 3 miles west of Marysville, just north of Highway 2, in lot 18 or 19, concession I, Tyendinaga Township, Hastings County.

The 22.5-foot quarry face is in Upper Bobcaygeon Limestone. Less than 1 foot of overburden covers the even bedrock surface locally.

The horizontal beds are medium grey, fine crystalline and fossiliferous. The section is described in Table 61.

A chemical analysis of a sample of 1-inch crushed stone from the stockpile is given in Table 62.

QUARRY OPERATION

Loading at the quarry face is by ¾-cubic yard, Model 45, Unit shovel. Dump trucks haul the rock to a portable primary jaw crusher located at the bottom of a ramp. Via surge bin the product goes to a portable Cedarapids crushing and screening plant. From this plant crushed stone is loaded directly onto trucks by conveyor belt. A bulldozer and a water pump are available on the property.

H. J. McFarland Construction Company (69)

MOUNT CARMEL QUARRY

A quarry was opened by McFarland Construction Company on the northeastern corner of the intersection of Highway 49 with Fish Lake Road, west of Mount Carmel, on lot 38, concession I, S.W., G.P., Sophiasburg Township, Prince Edward County.

The quarry is inactive and partly flooded. Eighteen feet of grey, predominantly medium-bedded limestone of the Lindsay Formation were exposed above the waterline at the time of visiting. The section is described in Table 63.

A chemical analysis of a sample of ½-inch crushed stone from the stockpile is given in Table 64.

The quarry appeared to be about 20 feet deep. An even bedrock surface is overlain by 1 to 2 feet of overburden. Calcite-filled joints are common.

A Ready Mix concrete plant was operated at the quarry site in 1971 in connection with a local road construction program. However, aggregate for this plant was brought in from elsewhere.

Table 59 | QUARRY SECTION – H. J. McFARLAND CONSTRUCTION COMPANY, KINGSTON QUARRY

UNIT	DESCRIPTION	THICKNESS FEET
Gull River Limestone, Member D		
MT1	Limestone: medium grey; fine crystalline to lithographic; thin to thick bedded; medium brownish grey in part; shaly partings; thick, fine crystalline marker bed at 11.7 feet	30.7

Table 60 CHEMICAL ANALYSIS – H. J. McFARLAND CONSTRUCTION COMPANY, KINGSTON QUARRY

COMPONENTS IN PERCENT								
SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	P_2O_5	SO_3	L.O.I.	TOTAL
4.29	1.26	0.59	1.13	51.2	0.03	0.73	41.0	100.2

Table 61 QUARRY SECTION – H. J. McFARLAND CONSTRUCTION COMPANY, MARYSVILLE QUARRY

UNIT	DESCRIPTION	THICKNESS FEET
Upper Bobcaygeon Limestone		
	Limestone: medium grey to medium light grey, grey weathering; medium crystalline to aphanitic; thin to thick, predominantly medium bedded; shaly partings; fossiliferous calcarenite	22.5

Table 62 CHEMICAL ANALYSIS – H. J. McFARLAND CONSTRUCTION COMPANY, MARYSVILLE QUARRY

COMPONENTS IN PERCENT								
SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	P_2O_5	SO_3	L.O.I.	TOTAL
1.88	0.59	0.27	0.64	53.7	0.03	0.28	43.0	100.4

Table 63 QUARRY SECTION – H. J. McFARLAND CONSTRUCTION COMPANY, MOUNT CARMEL QUARRY

UNIT	DESCRIPTION	THICKNESS FEET
Lindsay Formation		
MM2	Limestone: medium grey to medium brownish grey, buff weathering; medium to fine crystalline; shaly partings; fossiliferous; brachiopods; nodular weathering calcarenite	3.0
MM1	Limestone: medium grey, bluish grey weathering; fine to medium crystalline; medium bedded; shaly partings; in many places greenish-grey mottling on weathered surface; fossiliferous; brachiopods	15.1
	Total	18.1

Table 64 CHEMICAL ANALYSIS – H. J. McFARLAND CONSTRUCTION COMPANY, MOUNT CARMEL QUARRY

COMPONENTS IN PERCENT								
SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	P_2O_5	SO_3	L.O.I.	TOTAL
6.97	1.53	0.88	1.60	48.8	0.07	0.97	40.1	100.9

ODM8576

Photo 5–Picton Quarry, H. J. McFarland Construction Company; October 1971.

H. J. McFarland Construction Company (70)

PICTON QUARRY

A quarry is operated by McFarland Construction Company on lot 19, concession I, S.W., G.P., Sophiasburg Township, Prince Edward County, approximately 4 miles northeast of Picton.

In May 1969, a 17.5-foot quarry face exposed thin- to medium-bedded Lindsay Limestone. The section is described in Table 65.

The quarry is located on high ground. A maximum of 3 feet of overburden covers the bedrock surface. The limestone appears thick bedded when freshly quarried.

In October 1971, Granular 'A' aggregate was taken from stockpiles for road construction in the area. A 2-cubic yard Michigan front-end loader and a 1½-cubic yard Northwest shovel were available on the property.

McGinnis and O'Connor Limited (71)

ELGINBURG QUARRY

The Elginburg or No. 3 quarry of McGinnis and O'Connor is located in lot 15, concession V, Kingston Township, Frontenac County, approximately ½-mile west of Elginburg and ¼-mile south of the road to Glenvale. The quarry supplies the company with concrete aggregate for its Kingston operations. The quarry is 10 feet deep at present and exposes medium- to thin-bedded, medium grey calcarenite to calcilutite of the Gull River Formation, Member D. The section is described in Table 66.

Table 65 | QUARRY SECTION – H. J. McFARLAND CONSTRUCTION COMPANY, PICTON QUARRY

UNIT	DESCRIPTION	THICKNESS FEET
Lindsay Formation		
MP1	Limestone: calcarenite to calcilutite; calcarenite: medium grey; medium crystalline; thin to medium bedded; fossiliferous; brachiopods; calcilutite: medium dark grey; fine crystalline to aphanitic; thin to medium bedded; shaly partings; argillaceous; minor nodular weathering in thin bedded upper beds	17.4

Table 66 | QUARRY SECTION – McGINNIS AND O'CONNOR LIMITED, ELGINBURG QUARRY

UNIT	DESCRIPTION	THICKNESS FEET
Gull River Formation Member D		
ME2	Limestone: medium grey; medium bedded; fossiliferous calcirudite to calcarenite; 0.2 feet shale at base	2.5
ME1	Limestone: medium grey; thin bedded; fine crystalline to lithographic; calcarenite to calcilutite	7.5
	Total	10.0

Table 67 | CHEMICAL ANALYSIS – McGINNIS AND O'CONNOR LIMITED, ELGINBURG QUARRY

COMPONENTS IN PERCENT							
SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	L.O.I.	TOTAL	CO_2
4.43	1.70	0.74	1.19	50.4	40.8	99.26	40.9

A chemical analysis of a sample of ½-inch crushed stone from the stockpile is given in Table 67.

QUARRY OPERATION

Two Wagon drills drill 2½-inch holes in a 6- by 6-foot patttern. Stone is loaded at the face by a 1-cubic yard shovel and hauled by truck to the semi-permanent crushing and screening plant.

The plant consists of a primary jaw crusher and a secondary 43- by 30-inch Ceparapids hammermill, in closed circuit with one single and one double-deck screen.

The framework for this installation with conveyor belts and hoppers for loading was entirely designed and built by the company. A dry dust collector with a vacuum cylinder containing 72 bags collects 90 percent of all dust from points where dust is generated.

McGinnis and O'Connor Limited (72)

PITTSBURG QUARRY

The Kingston (Pittsburg) quarry of McGinnis and O'Conner Limited on Highway 15, 2 miles north of Barriefield, Pittsburg Township, is described by Hewitt (1960, p.69-71; 1964, p.37).

The lower 19.2 feet of the quarry section belongs to a series of interbedded lithographic limestones and buff dolomites of the Gull River Formation. Ten feet of medium- to thick-bedded, medium brownish grey, fine crystalline to lithographic limestone with minor shaly parting and in places colour lamination is overlain by 9.2 feet of medium to light grey, silty dolomite with much shaly parting. The dolomite is buff, and in places, crumbly weathering.

QUARRY OPERATION

Changes have taken place in the crushing and screening operation. All crushers are electrically driven. The primary crusher is a 25- by 40-inch Cedarapids jaw crusher equipped with feeder and vibrating grizzly. Crushed stone proceeds to a 20- by 20-inch secondary Cedarapids impact crusher and from there to a 2-deck Cedarapids screen. Tertiary crushing of different sizes is carried out in a 33- by 40-inch Cedarapids hammermill or a 24-inch Simplicity centrifugal impact breaker in closed circuit with 2-deck 5- by 14-foot Simplicity screen. It is found that less flats and needles are produced with this change in the crushing routine.

All points of crushing are provided with air suction vents for dust control. A fan driven by a 50-horsepower electromotor exhaust dust-laden air through a wet scrubber using 300 gallons of water per minute. The scrubber is a 20-foot high tank with a diameter of 12 feet.

The quarry produces commercial grades of asphalt aggregate, Granular 'A'- and 'B'-crushed stone and washed chips. Stone for concrete aggregate is obtained from a quarry at Elginburg.

ODM8747

Photo 6–Pittsburg Quarry, McGinnis and O'Connor Limited; September 1971.

W. J. McKendry and Sons Limited (74)

KINGSTON QUARRY

A limestone quarry is operated by W. J. McKendry and Sons on the west side of Division Street, 3 miles north of Highway 401 on the northern outskirts of Kingston. It is described by Hewitt (1964, p.36).

The quarry is active on demand and serviced by a portable crushing and screening plant that is alternately used here, in the Kingston Township quarry at the intersection of Highways 38 and 401, and in a quarry on Amherst Island. Four front-end loaders of 3½- and 4-cubic yard capacity and a bulldozer are available for loading stone and for maintenance. A small office and a workshop are housed in a trailer on the property.

The quarry provides crushed stone for road construction and asphalt aggregate. A Pulvomatic stone pulverizer has been added to the equipment. Production of sand and finer grades of crushed stone will be undertaken in future.

W. J. McKendry and Sons Limited (75)

KINGSTON QUARRY No. 2

The Kingston Township quarry, located on lot 12, concession IV, Kingston Township, Frontenac County, on the southeast corner of the intersection

Table 68 | QUARRY SECTION – McKENDRY AND SONS LIMITED, KINGSTON QUARRY NO. 2

UNIT	DESCRIPTION	THICKNESS FEET
Gull River Formation, Member D		
KT2	Limestone: medium grey, light grey weathering; fine to microcrystalline; medium to thick bedded; coquinoid calcarenite; calcite crystals	3.0
KT1	Limestone: medium grey; fine to microcrystalline; thin to thick bedded; prominent bed from 5 to 7 feet; shaly partings; minor pyrite from 7 to 12 feet	17.4
	Total	20.4

Table 69 | CHEMICAL ANALYSIS – McKENDRY AND SONS LIMITED, KINGSTON QUARRY NO. 2

COMPONENTS IN PERCENT								
SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	P_2O_5	SO_3	L.O.I.	TOTAL
3.46	0.94	0.36	0.96	51.5	0.02	0.34	41.8	99.4

of Highways 401 and 38, is operated for the Township by McKendry and Sons.

The quarry was inactive in September 1971. The bedrock surface is even. Overburden is not more than 2 feet thick in the area.

Twenty feet of medium grey, fine to microcrystalline limestones of the Gull River Formation, Member D, are exposed in the quarry face. The section is described in Table 68.

A chemical analysis of a sample of 1-inch crushed stone from the stockpile is given in Table 69.

QUARRY OPERATION

The quarry is operated on demand with a company-owned portable crushing and screening plant.

Menard Construction Limited (77)

KINGSTON

A quarry is operated by Menard Construction Limited on the northern outskirts of Kingston, about 3 miles north of Highway 401 on the west side of Division Street. This quarry was opened in the summer of 1968 in connection with reconstruction of Division Street. It is located to the south of and is adjacent to the quarry of McKendry and Sons.

The quarry face is from 10 to 16 feet high; there is up to 2 feet of overburden covering the irregular bedrock surface. An identical section of medium grey, thin- to medium-bedded, medium- to microcrystalline limestone with shaly partings, belonging to the Gull River Formation, Member D, is excavated in both quarries. The quarry was not active in 1971.

Permanent Concrete Limited (84)

CORNWALL QUARRY

A quarry is operated by Permanent Concrete Limited on lot 25, concession IV, Cornwall Township, Stormont County. The quarry was opened in 1967.

Approximately 45 feet of Middle Black River Limestone is quarried in 3 lifts. The floor is in dolomite ascribed to the Lower Black River Formation. The section is described in Table 70.

Chemical analyses of chip samples of the quarry face are given in Table 71.

Table 70 | QUARRY SECTION – PERMANENT CONCRETE LIMITED, CORNWALL QUARRY

UNIT	DESCRIPTION	THICKNESS FEET
Middle Black River		
PC2	Limestone: medium grey; massive bedded; fine crystalline to aphanitic; calcarenite to calcilutite; abundant calcite-filled fossil cavities	15.0
PC1	Limestone: medium grey to medium brownish grey, grey weathering; medium bedded, in places massive appearance; fine crystalline to aphanitic; calcarenite to calcilutite; minor reefs; minor calcite-filled vugs and fossil cavities	28.8
	Total	43.8

Table 71 | CHEMICAL ANALYSES – PERMANENT CONCRETE LIMITED, CORNWALL QUARRY

FEET ABOVE FLOOR	COMPONENTS IN PERCENT							
	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	L.O.I.	TOTAL	CO_2
28.8–43.8	1.01	0.95	0.60	0.91	53.5	43.0	99.97	42.0
0 –28.8	6.34	3.33	1.08	1.47	48.3	38.6	99.12	38.9

ODM8748

Photo 7–Portland Township Quarry; September 1971.

QUARRY OPERATION

Drilling and blasting are contracted to Armac Drillers Limited of Ottawa. Holes are 2½ inches in diameter and spaced in a 10- by 10-foot pattern.

Loading of stone at the face is done by a 1½-cubic yard Koehring shovel or a 3½-cubic yard Caterpillar front-end loader. Two 22-ton Euclid trucks are available for hauling stone. A Caterpillar, Model D6 bulldozer, is used for maintenance work.

A permanent crushing and screening plant is erected at road level. Stone is fed to a 36- by 43-inch Heavy Duty Cedarapids hammer crusher via a feeder with double-deck grizzly. Minus ⅝-inch stone is taken out for direct sale. The crusher can be set for any size smaller than 7 inches.

There are two 3-deck, 5- by 12-foot Tyler screens in the screening tower. Six hoppers receive the screened products and a seventh is available for overflow. Oversizes are rerouted by 30-inch conveyor belt to the primary crusher, which is equipped with a surge bin.

Products are sold for road construction or delivered to a company-owned concrete mixing plant in Cornwall.

Portland Township Quarry (86)

The Portland Township quarry is located in a mantled cliff forming the northwest bank of Wilton Creek, 3¼ miles northwest of Sydenham. It is in lot 3, concession VII, Portland Township, Frontenac County. The site was originally excavated for sand and is now operated as a quarry for the Township by W. J. McKendry and Sons Limited. Alternating limestone and dolomite of the Gull River Formation, Member A, are exposed in the 27.5-foot high quarry face. The section is described in Table 72.

A chemical analysis of a sample of ½-inch crushed stone from the stockpile is given in Table 73.

QUARRY OPERATION

The quarry is operated on demand with portable equipment.

Rama Township Quarry (88)

HARTINGTON

A quarry located on lot 3, concession E, Rama Township, Ontario County, is operated on contract for the Township. All equipment used is portable.

The quarry is opened on the north side of a minor escarpment of Gull River Limestone. The face is 18 feet high and the floor of the quarry exposes green siltstone belonging to the Shadow Lake Formation. The bedding is horizontal. Up to 6 inches of soil cover the flat bedrock surface. The quarry section is described in Table 74.

Table 72 | QUARRY SECTION — PORTLAND TOWNSHIP QUARRY, HARTINGTON

UNIT	DESCRIPTION	THICKNESS FEET
Gull River Formation, Member A		
PT1	Limestone and Dolomite; Limestone: brown to medium grey; thick to medium bedded, in places massive bedded; fine crystalline to aphanitic or lithographic; some colour banding, in places mottled appearance due to dark grey; shaly limestone; Dolomite: medium grey to light greenish grey; aphanitic; single thick beds. Upper 4 feet massive; buff weathering limestone	27.5

Table 73 | CHEMICAL ANALYSIS — PORTLAND TOWNSHIP QUARRY, HARTINGTON

COMPONENTS IN PERCENT							
SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	L.O.I.	TOTAL	CO_2
4.01	2.30	0.86	4.08	47.3	41.0	99.55	40.5

Table 74 | QUARRY SECTION — RAMA TOWNSHIP QUARRY

UNIT	DESCRIPTION	THICKNESS FEET
Gull River Formation, Member A		
R3	Limestone: dolomitic; light brown and buff mottled or banded; buff, dolomitic part predominant; lithographic to fine crystalline; massive bedded; 0.3 feet of thin bedded; crumbly weathering; shaly limestone with abundant shaly parting at base	3.1
R2	Limestone: brown, mottled, brown to grey weathering; medium to thick bedded; shaly parting; minor light grey chert nodules and some glauconite in upper 2 feet ..	7.1
R1	Limestone: alternating medium grey, fine crystalline and brown; lithographic; thin to thick bedded with thick, lithographic beds predominant; shaly parting; 4 feet at base of section not exposed	7.9
	Total	18.1

Table 75 | CHEMICAL ANALYSIS — RAMA TOWNSHIP QUARRY

COMPONENTS IN PERCENT						
SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	L.O.I	TOTAL
4.60	2.06	0.94	3.73	47.7	40.9	99.93

ODM8749

Photo 8–Rama Township Quarry; November 1971.

A chemical analysis of a sample of ⅞-inch crushed stone from the stockpile is given in Table 75.

Richmond Township Quarry (89)

A small quarry west of Highway 41, ¾ mile south of Roblindale Station, was operated for the Township in May 1969. The quarry is located on lot 21, concession VII, Richmond Township, Lennox and Addington County.

In the face of the quarry, 12½ feet of fine crystalline to aphanitic, medium grey to medium dark grey calcilutite is exposed. The upper 6 feet of limestone appear massive in the quarry face. Irregular films of shale occur throughout. The upper beds are fossiliferous and light grey weathering near the surface. In the lower half of the section beds are thin to medium bedded with shaly partings. All beds are tentatively assigned to the Gull River Formation. The section is described in Table 76.

Table 76 | QUARRY SECTION – RICHMOND TOWNSHIP QUARRY

UNIT	DESCRIPTION	THICKNESS FEET
Gull River Formation		
RT2	Limestone: medium grey, light grey weathering; fine crystalline to aphanitic; massive bedded; shaly films; fossiliferous calcilutite	6.7
RT1	Limestone: medium dark grey; aphanitic; thin to medium bedded; shaly partings; calcilutite	5.9
	Total	12.6

QUARRY OPERATION

The quarry is operated on contract. Crushing and screening are done by portable Cedarapids plant; ⅞-inch crushed stone and 2-inch crusher run are produced. Two front-end loaders were available for loading at the face and from stockpiles.

Roblindale Quarries Limited (91)

ROBLINDALE

The quarry and plant of Roblindale Quarries Limited, on Highway 41, north of Napanee, near Roblindale, in Camden Township, Lennox and Addington County, is described by Hewitt (1960, p.61-63).

St. Lawrence Cement Company Limited (93)

CEMENT PLANT, CLARKSON, ONTARIO

In 1956, St. Lawrence Cement Company Limited opened a new two-kiln, wet-process portland cement plant at Clarkson, on Lake Ontario about 15 miles west of Toronto. This plant is described by Hewitt (1960, p.51-53). The two wet-process kilns have a capacity of about 700,000 tons per year.

In 1965, the company began an expansion program at the Clarkson plant with the installation of new raw material stockpiling and reclaiming facilities. New crushing and grinding equipment, and a dry-process kiln with an annual capacity of approximately 1,000,000 tons were installed, and the kiln began operation in April 1968.

MATERIALS, HANDLING, CRUSHING, AND GRINDING

The shaly Trenton Limestone, quarried at the Ogden Point quarry, is crushed at the quarry by a 54-inch Traylor gyratory crusher with a capacity of 2,000 tons per hour. The product is minus 8-inch stone, which goes via conveyor to stockpiles that have a capacity of 70,000 tons. The stone is loaded on a self-unloading lake boat by a conveyor that has a capacity of 1,500 tons per hour.

The stone is unloaded at the dock at Clarkson and hauled by rear dump trucks to a 500,000 ton stockpile on an outdoor storage area above a 280-foot concrete reclaiming tunnel equipped with a 42-inch Jeffrey reclaiming conveyor. The stone from the stockpile is conveyed to an air swept Aerofall mill, 27 feet in diameter and 5 feet 8 inches long. The dry product from the Aerofall mill is classified in a 10-foot square, 19-foot high vertical classifier, which is followed by two 33-foot high cyclone classifiers, and six cyclone collectors. Dust collection is by a Joy Cottrell electrostatic dust precipitator. The oversize from the classifiers goes to two 8-foot by 37-foot regrind mills, which are converted slurry mills from the older mill system. The products from the regrind mills and the cyclone collectors are the final raw mill product and travel by air slide conveyors and belt conveyor to four 44-foot by 185-foot high kiln feed silos.

KILNS AND KILN FEED

The kiln feed for the wet-process kilns goes to an 8-foot by 37-foot Compeb slurry mill. The slurry is pumped to four 80-foot slurry basins having a capacity of 6,000 tons each. The wet-process kilns are described by Hewitt (1960, p.52).

The primary components of the new dry process kiln system include a dual Fuller-Humboldt preheater with 4 stages in each unit, a 17-foot by 276-foot Traylor kiln with a capacity of 3,000 tons per day, a 3-grate Fuller clinker cooler, and pair of Joy Cottrell electrostatic dust percipitators in parallel. The kiln is fired with Bunker C fuel oil.

The clinker goes to a clinker storage area served by a 20-ton overhead bucket crane on a 120-foot span.

CLINKER GRINDING

The cement grinding mills have not been changed. These consist of five 2-compartment, 10-foot by 28-foot, Compeb ball mills each having a capacity of 33 tons per hour, rotating at 16.8 revolutions per minute. Gypsum is added to the ball mill feed. Each ball mill is in closed circuit with a Sturtevant air classifier, which returns the oversize to the ball mills.

CEMENT STORAGE AND PACKING

Cement is pumped to the cement packing plant where there are two rows of ten 54-foot high silos, each with a capacity of 8,000 barrels. Much of the cement is shipped in bulk, but there are five 4-spout bagging machines. Two 850-ton silos are provided for bulk loading on the wharf.

A new bulk truck loading station has been constructed consisting of two 52-foot by 190-foot silos having a capacity of 15,000 tons each, and two hopper scales.

St. Lawrence Cement Company Limited (94)

OGDEN POINT QUARRY

The Ogden Point quarry of St. Lawrence Cement Company is described by Hewitt (1960, p.49-51; 1964, p.29-30). The quarry has been deepened and is now operated in two lifts of 50 feet each. Shale interbedded with limestone occurs at a depth of 12 feet below the floor of the second lift.

QUARRY OPERATION

A Joy Champion drill drills 7⅞-inch holes.

A permanent primary crusher station is built in the centre of the quarry below the floor of the first lift. Crushed stone is extracted at the bottom of the crusher approximately 25 feet below the floor of the second lift. A conveyor belt carries stone to stockpiles at the entrance of the quarry near the waterfront.

St. Marys Cement Company Limited (95)

BOWMANVILLE PLANT AND QUARRY

The Bowmanville quarry and cement plant of St. Marys Cement Company are located south of Bowmanville on the south side of Highway 401 and the Canadian National Railways tracks, just west of Waverley Road. The initial quarry opening is in lot 15, Broken Front Concession, Darlington Township, Durham County.

In 1963, St. Marys Cement Company began a search for a possible plant location east of Toronto on Lake Ontario. Test drilling along a 12-mile stretch indicated optimum conditions for overburden thickness and stone quality southwest of Bowmanville. Options were taken up, and extensive block drilling was carried out proving up ample reserves of good grade Upper Trenton Limestone, overlain by glacial till and varved clays. After negotiations with local authorities, zoning approvals were obtained in May 1966. Engineering studies were carried out, and in early 1967 contracts were awarded for the construction of the plant. The 350,000 tons per year, one kiln, wet-process cement plant began production in November 1968.

GEOLOGY

The upper 12 to 18 feet of rock exposed in the quarry is argillaceous limestone of the Whitby (Collingwood) Formation. It is dark brown, fissile, and thin-bedded. It is separated from the underlying Trenton (Lindsay) Limestone by 6 inches of black to dark grey shale. The lower 55 feet consist of limestone, medium to light grey weathering, microcrystalline to fine crystalline, calcilutite to calcarenite, medium to thin bedded, with shaly partings. This limestone is part of the Upper Trenton (Lindsay Formation).

The average analysis of the stone from the upper lift is given by the company as follows: loss on ignition, 33.4 percent; silica, 16.8 percent; iron oxide, 1.7 percent; alumina, 5.5 percent; lime, 39.7 percent. The average analysis of the stone from the lower lift is given by the company as follows: loss on ignition, 37.6 percent; silica, 9.9 percent; iron oxide, 1.0 percent; alumina, 3.4 percent; lime, 46.3 percent.

Chemical analyses of a typical drill hole, No. B22, on the Bowmanville property, were kindly provided by St. Marys Cement Company (Table 77). The hole is in lot 15, Broken Front Concession, Darlington Township.

Table 77 — CHEMICAL ANALYSES FROM CORE OF DIAMOND DRILL HOLE B22 – ST. MARYS CEMENT COMPANY LIMITED, BOWMANVILLE

DEPTH	L.O.I.	SiO_2	Fe_2O_3	Al_2O_3	CaO	MgO
22–25	29.89	21.25	2.65	6.74	36.30	1.32
25–30	30.06	20.78	2.34	6.61	36.40	1.71
30–35	31.16	19.95	2.00	6.25	37.40	1.79
35–40	35.67	13.70	1.30	4.02	42.75	1.40
40–45	34.64	15.40	1.50	4.58	41.20	1.73
45–50	36.47	12.32	1.18	3.64	44.60	1.89
50–55	34.38	15.36	1.53	4.76	40.85	2.04
55–60	37.28	10.32	1.07	3.08	46.25	1.40
60–65	36.31	12.35	1.26	3.73	44.18	1.79
65–70	38.30	8.15	1.04	2.71	48.10	1.80
70–75	36.08	12.28	1.26	3.92	43.80	1.69
75–80	37.47	10.30	1.07	3.24	46.22	1.70
80–85	37.50	9.80	1.08	3.18	46.38	1.71
85–90	38.03	8.65	1.01	2.88	47.85	1.55
90–95	37.69	9.35	1.04	3.05	46.96	1.63
95–100	37.30	9.95	1.08	3.21	46.30	1.57
100–105	35.05	14.40	1.43	4.48	41.50	2.26
105–110	35.40	14.00	1.37	4.28	42.22	2.06
110–115	38.07	8.45	.97	2.82	48.10	1.44
115–120	38.18	8.75	.98	2.90	47.80	1.36
120–125	38.68	7.25	.96	2.50	49.00	1.75
125–130	37.14	10.78	1.17	3.37	45.62	2.02
130–135	34.49	16.00	1.56	4.80	40.50	2.28
135–140	35.83	13.40	1.36	3.88	42.80	2.10
140–147	36.30	12.03	1.30	3.65	43.85	2.31

QUARRY OPERATION

Overburden at the Bowmanville quarry is thick, ranging from about 20 to 38 feet in thickness. It is

composed of glacial till and varved clay. Some of the till is highly compacted. Overburden is stripped by a 6-cubic yard Caterpillar model 988 loader. Haulage is by 45-ton and 22-ton Euclid trucks. The overburden is now used to fill a low swampy section of the property.

The quarry is worked to a depth of 70 feet in two benches. The upper bench averages 15 feet and ranges from 12 to 18 feet. This bench consists principally of the Collingwood (Whitby) Formation, here an argillaceous limestone higher in alumina and silica than the underlying Upper Trenton (Lindsay) Limestone. The lower bench is 55 feet in height and consists of the Upper Trenton Limestone. The quarry face is drilled by a Gardner-Denver RDC 16A rotary drill, drilling a 5-inch hole on a 15- by 17-foot pattern. The blasting agent is prilled ammonium nitrate. No secondary blasting is required.

The stone is loaded by the 6-cubic yard Caterpillar model 988 loader. A 3-cubic yard diesel shovel is on standby. Haulage is by one 45-ton and three 22-ton Euclid rear dump trucks.

CRUSHING AND SCREENING

The trucks discharge the rock into a 54-inch gyratory crusher, which crushes the rock to minus 8 inches. The product is conveyed to the limestone storage stockpile where a reversible shuttle belt conveyor feeds two 25,000-ton surge piles and two 2,000-ton concrete storage silos. One surge pile and silo is used for the 'low carbonate' Collingwood Formation rock, and one surge pile and silo for the 'high carbonate' Upper Trenton Limestone.

A reclaiming belt conveyor operates in a tunnel under the stockpiles and silos. The stone is conveyed to a secondary reversible impact crusher, which reduces the stone to minus ¾-inch size. The reversible impactor is in closed circuit with two vibrating screens. Belt conveyors carry the crushed stone to the raw mill feed silos, which have a combined storage capacity of about 9,000 tons. Raw mill feed silos are also provided for sand and iron oxide, which are delivered to the plant by pneumatic tank trucks.

Coal and gypsum are unloaded at the unloading station and conveyed to silos in the mill feed area. Both materials are ground to minus 1-inch size by a ring granulator.

RAW GRINDING AND SLURRY HANDLING

Raw grinding is carried out in a three-compartment Unidan tube mill 12 feet in diameter and 34 feet long. Mill feed and water are automatically controlled. The slurry product from the tube mill is discharged into a sump pit from which it is pumped to one of two 80-foot diameter by 25-foot high slurry basins. Each basin has a capacity of 11,800 cubic feet of slurry, equivalent to two and one half days kiln feed.

KILN AND CLINKER HANDLING

The rotary kiln is 14 to 16 feet in diameter and 480 feet long. Hot clinker is discharged into a two-stage Folax grate cooler with a hammer mill between the stages to break up larger clinkers. The clinker is conveyed to the clinker stockpile and fines silo or directly to the clinker feed silos of which there are four, with a total capacity of 6,000 tons.

FINISH GRINDING, STORAGE, AND SHIPPING

The finish grinding mill is a two-compartment Unidan tube mill 12 feet in diameter and 34 feet long, in closed circuit with a bucket elevator and air separator.

The finished cement is stored in 10 silos having a total capacity of 44,000 tons. Cement is loaded into either road tank trucks or railroad cars by a system of air slides and telescopic spouts.

All production functions except primary crushing and cement loading are controlled from the control panel by a series of 40 Analog control loops. The description of the plant was kindly provided by St. Marys Cement Company.

Woods Sand and Gravel (101)

COLLINS BAY ROAD QUARRY

A quarry is operated by Woods Sand and Gravel on the Collins Bay Road, 1 mile southeast of Westbrook, on lot 3, concession III, Kingston Township, Frontenac County.

A 16-foot quarry face exposes medium grey to medium brownish grey limestones of the Gull River Formation. The section is described in Table 78.

A chemical analysis of a chip sample of the quarry face is given in Table 79.

There is up to 6 feet of overburden overlying the uneven west-sloping bedrock surface.

QUARRY OPERATION

Drilling is done on contract. A portable crushing and screening plant is fed from the face by front-end loader of which there are three available e.g. 2 Terex

Table 78 | QUARRY SECTION – WOOD'S SAND AND GRAVEL, COLLINS BAY ROAD QUARRY

UNIT	DESCRIPTION	THICKNESS FEET
Gull River Formation, Members C and D		
WS3	Limestone: medium grey; medium crystalline to aphanitic; thin to thick bedded, fissile in part; fossiliferous calcarenite near top; shaly partings; 0.2 feet shale at base	5.6
WS2	Limestone: dolomitic; medium grey; fine to microcrystalline; medium to thick bedded; calcarenite with irregular colour laminations; shaly partings	5.0
WS1	Limestone: medium brownish grey; lithographic to fine crystalline; medium to thin bedded, in part laminated	5.7
	Total	16.3

Table 79 | CHEMICAL ANALYSIS – WOOD'S SAND AND GRAVEL, COLLINS BAY ROAD QUARRY

COMPONENTS IN PERCENT								
SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	P_2O_5	SO_3	L.O.I.	TOTAL
8.96	2.50	0.96	0.90	47.2	0.03	1.52	37.3	99.4

Euclid loaders of 3- and 3½-cubic yard capacity and one 1¼-cubic yard Massey Ferguson loader. The primary crusher is a 24- by 40-inch Cedarapids jaw crusher. It is followed by a secondary Telsmith 4-foot cone crusher with grizzly, in closed circuit with a 2-deck Telsmith screen. Crushed stone is stockpiled by stacker conveyor or directly loaded on trucks. A Gilson hammermill with a 4- by 8-foot screen is used for production of minus ¼-inch stone. Products are used for road construction.

Guelph-Lockport Dolomite

The Guelph-Lockport (Albemarle) Dolomite belongs to the Niagaran Series of Middle Silurian age.

The lower part of the dolomite forms the Niagara Escarpment extending from Niagara Falls through Hamilton, north through Georgetown and Orangeville to the Bruce Peninsula. The formation dips southwest and forms a wide band extending back from the Escarpment for several miles. From Niagara Falls to Hamilton the dolomite outcrops in a band 8–10 miles wide, south of the Escarpment. From Hamilton northwest to the Bruce Peninsula the Guelph-Lockport Dolomite (in this area called the Guelph-Amabel Dolomite) is exposed in a belt 20–25 miles wide extending west from the Escarpment.

The Guelph-Lockport Dolomite has a total thickness of 170–250 feet in the outcrop area but thickens considerably in subsurface to the southwest.

The Guelph-Lockport Dolomite has been restudied by T. E. Bolton (1957) whose memoir gives the latest revised stratigraphy and many excellent descriptions of sections along the Escarpment. The stratigraphic nomenclature used here follows that of Bolton and is given in Table 80.

Table 80 | STRATIGRAPHIC NOMENCLATURE – GUELPH-LOCKPORT DOLOMITE (AFTER T. E. BOLTON 1957)

	Niagara Falls–Dundas Area		Waterdown-Georgetown-Bruce Peninsula	
	FORMATIONS	MEMBERS	FORMATIONS	MEMBERS
Albemarle Group	Guelph Dolomite		Guelph Dolomite	
	Lockport Dolomite	Goat Is.	Amabel Dolomite	Eramosa
		Eramosa		Wiarton
		(Ancaster Chert Beds)		Colpoy Bay
		Gasport		Lions Head

Lockport Formation

From Niagara Falls to Dundas and Clappisons Cut the Lockport Dolomite Formation is divided into three members as indicated in Table 80: the Gasport Member, the Goat Island Member, and the Eramosa Member.

Gasport Member

The Gasport, the lowest member of the Lockport Formation, is a medium crystalline, crinoidal, dolomitic limestone or dolomite, generally massive to thick-bedded, bluish grey to light buff in colour. It varies in thickness from 4.4 feet at Stoney Creek to 33 feet at Queenston Quarries. This member is quarried for building stone at Queenston Quarries. The Gasport Member rests unconformably on the DeCew Dolomite or, where this formation has been removed by erosion, directly on the Rochester Shale. The unconformable contact between the Gasport and the underlying DeCew Dolomite is well shown at Walker Brothers quarry near Thorold, where the rolling surface of the DeCew Dolomite shows at least 20 feet of relief. Goudge (1938, p.278) described these mounds of DeCew Dolomite as "reef-like masses extending upward into the Gasport." It is most likely that the irregular character of the contact is due entirely to erosional unconformity. The Gasport greyish crinoidal member grades upward into brownish to light buff, fine crystalline to aphanitic dolomite of the Goat Island Member. There is a change of lithology and colour.

Goat Island Member

The Goat Island Member is an aphanitic to fine-crystalline, light buff to light brownish grey, massive to thick-bedded, dolomite. In places bluish grey and white chert are abundant, and the chert-bearing facies has been distinguished as the "Ancaster Chert Beds." The chert beds generally occur at the base of the Goat Island Member and are most common in the Ancaster-Stoney Creek area; they may be seen at the King City Sand and Crushed Stone quarry, at the Sydenham roadcut (Dundas), at the base of the section of Canada Crushed Stone (Dundas quarry), at the Ancaster roadcut, at the Wentworth Street roadcut in Hamilton, at the Highway 20 cut at Stoney Creek, at the base of the section at Armstrong Brothers Vinemount quarry, and at DeCew Falls. The Goat Island Member at Queenston Quarries, Walker Brothers quarry, St. Catharines Crushed Stone, and Vineland Quarries shows no chert. The thickest section of Goat Island Dolomite measured was that at St. Catharines Crushed Stone where the member is 32 feet thick, but it may be considerably thicker in other places. Bolton (1957, p.50) suggested a variable thickness for the Goat Island up to 60–80 feet. The upper limit of the Goat Island is arbitrarily drawn at the first appearance of the dark brown to black bituminous material characteristic of the dark brown sugary Eramosa Member.

Eramosa Member

The Eramosa Member is a dark brown to medium brownish grey, aphanitic to sugary, medium- to thin-bedded, dark grey streaked dolomite with bituminous or shaly partings. The typical Eramosa is exposed in the 50-foot quarry face at the Dundas quarry of Canada Crushed Stone. It is also exposed at Vinemount Quarries and the A. Cope and Son quarry, Stoney Creek. In these latter quarries the Vinemount Shale Beds of the Eramosa Member are exposed near the base of the Eramosa and have a maximum thickness of 17 feet. This shaly unit has poor soundness and is unsatisfactory for concrete aggregate. The lateral extent of this shaly unit is unknown, but it was observed from Dundas to Vinemount, and its thickness and extent is of interest to operators planning commercial aggregate quarries in the area.

The Eramosa Member extends throughout the Niagara Peninsula and northward to the Bruce Peninsula and apparently attains its maximum thickness at Dundas where 58 feet are exposed in the old quarry of Canada Crushed Stone. It is overlain by the light buff dolomite of the Guelph Formation.

Amabel Formation

Throughout the Niagara Peninsula and as far as Clappisons Cut, the Lockport Formation is divided into three members: Gasport, Goat Island, and Eramosa. However, in the Clappisons Cut-Waterdown area there is a noteworthy facies change, and this stratigraphic unit is replaced by a reefy, medium crystalline, light buff dolomite, which extends from Waterdown through Georgetown to the Bruce Peninsula. This facies, which is the lateral equivalent of the Lockport, is named the Amabel Formation by Bolton. The Lockport therefore changes its name to

the Amabel Formation and its lithology to a reefy dolomite in the Waterdown area.

The quarry sections from Waterdown to Georgetown are all in the reefy Amabel Formation. In this area the formation is not divisible into members but consists of a light grey to buff, buff-weathering, medium- to coarse-crystalline, massive to irregularly bedded and reefy, fossiliferous dolomite. The maximum thickness exposed is 84 feet at the Milton quarry of Gypsum Lime and Alabastine Company. All the quarry faces are composed of Amabel Dolomite at Nelson Crushed Stone, Lowville Quarries, Milton Quarries, Halton Quarry, and the quarries in the Georgetown area.

In the Bruce Peninsula, Bolton (1957, p.51-57) divided the Amabel Formation into four members; Lions Head, Colpoy Bay, Wiarton, and Eramosa; but in the Waterdown-Georgetown area, where most of the commercial quarries utilizing Amabel Dolomite are located, the formation is not divided into members but is remarkably uniform, except for reefy zones. No chert is present.

As decribed earlier, the lower member of the Lockport Formation rested on the underlying DeCew Dolomite or Rochester Shale of the Clinton Group. Below the Rochester Shale there are the Irondequoit Limestone and the Reynales Dolomite. These may be seen in the Highway 20 section at Stoney Creek, at Wentworth Street (Hamilton), at Ancaster, at Sydenham Road (Dundas), at the King City quarry (Clappisons Cut), and at the old Nelson quarry east of Waterdown. However there is a lateral change in the formations of the Clinton Group as they pass to the north, and the Rochester Shale and Irondequoit Limestone pinch out in the vicinity of Waterdown. The last vestiges of the Rochester Shale are seen in the old Nelson quarry east of Waterdown as a thin, grey, shaly zone, 1 foot to 2 feet thick, with white gypsum spots. At the Nelson Crushed Stone quarry north of Highway 5, the Amabel Formation rests directly on the Reynales Dolomite.

The Reynales Dolomite is a medium grey to grey, mottled to streaky, buff weathering, aphanitic, medium-bedded dolomite easily distinguished in colour and texture from the overlying medium-crystalline Amabel Dolomite. The Reynales Dolomite is 6–8 feet thick and rests on Thorold sandstone and shale; it is an easily distinguished marker bed marking the base of the quarriable dolomite of the Niagara Escarpment from Nelson to Georgetown. It forms the quarry floor at quarries of: Nelson Crushed Stone, Milton Quarries Limited, Gypsum Lime and Alabastine Limited (Milton quarry), Armstrong Brothers Company Limited (Georgetown quarry), and Industrial Sand and Gravel (Georgetown). Below this horizon are the shales and sandstones of the Clinton Group.

Guelph Formation

The Guelph Formation, which overlies the Lockport and Amabel Formations, consists of light creamy buff, light buff weathering, aphanitic to fine- or medium-crystalline, porous dolomite, generally thick bedded. The lower contact with the underlying Eramosa is marked by the change to medium to dark brown, bituminous dolomite with dark grey, shaly streaks.

The Guelph Formation is also characterized by reefy facies. These consist of medium to coarsely crystalline, irregularly bedded or massive areas of highly fossiliferous, porous dolomite standing out as mounds within the surrounding bedded dolomite.

The contact of the Guelph Formation and the underlying Eramosa Member of the Lockport or Amabel Formations is seen at Canada Crushed Stone quarry (Dundas) where 7 feet of Guelph Dolomite overlies 43 feet of Eramosa Dolomite along the north quarry face.

The Guelph Formation is quarried at Glenchristie by Domtar Chemicals Limited and at Guelph by Canadian Gypsum Company for the production of dolomitic lime. The contact with the underlying Eramosa is exposed at Guelph.

The Guelph Dolomite is overlain by the gypsum-bearing shales of the Salina Formation.

Angelstone Limited (3)

HOPE BAY

A building stone quarry is operated by Angelstone Limited on lot 4, concession VIII, Albemarle Township, Bruce County. The quarry is located just west of the road ¾ mile south of the Hope Bay turn-off. It was briefly worked by Ebel Quarries previous to the beginning of present operations in 1968.

Mill blocks of very light grey, massive Amabel Dolomite are quarried. The dolomite is fine crystalline and streaked with grey. The appearance ranges from mottled to banded depending on the continuity of the bluish grey streaks.

In 1971, three levels of 6 feet each had been opened, the deepest part covering an area of approximately 50 by 100 feet. Blocks are drilled vertically by air-powered steel drills on a 10-foot long bar. When drilling the walls between holes the drill steel is guided by a parallel bar in the adjacent hole. After drilling of the vertical holes blasting of a minor charge suffices to shear the block from the quarry floor horizontally. It is then lifted to surface by a Koehring, Model 401, crane or directly loaded on trucks. Trucks are provided with either a winch or a loading bridge and crane.

ODM8750

Photo 9–Drilling of 6-foot mill blocks in building stone quarry, Angelstone Limited, Hope Bay; June 1971.

Armstrong Brothers Company Limited (4)

CLAPPISONS QUARRY

This quarry is described by Hewitt (1964, p.45) under Armstrong Brothers; and a description and quarry section is given by Hewitt (1960, p.112-113) under King City Sand and Crushed Stone Limited.

Armstrong Brothers Company Limited (6)

VINEMOUNT QUARRY

The Vinemount quarry of Armstrong Brothers Company Limited is described by Hewitt (1960, p.100-103). There are now one 18-foot lift and four 20-foot lifts. The lowermost lift exposes Gasport Limestone and DeCew Dolomite.

Drilling is carried out by three Air Trac drills, drilling 3-inch holes on a 7- by 7-foot pattern. Haulage is by three 12-ton International trucks. Crushing and screening is done by a portable plant. The primary crusher is a 25- by 40-inch jaw crusher. Secondary crushers are a 4¼-foot standard cone and a 4-foot short head cone.

Canada Crushed Stone Division (23)

Steetley Industries Limited

DUNDAS

The Dundas quarry and plants of Canada Crushed Stone Division of Steetley Industries Limited are described by Hewitt (1960, p.106-111; 1964, p.44). The entire quarry production now comes from the quarry on the north side of Highway 5, in lots 10 and 11, concession III, West Flamborough Township, Wentworth County. The plant capacity has now been increased to 800 to 1,000 tons per hour.

QUARRY OPERATIONS

Overburden ranges from 16 to 18 feet thick. It is stripped by a 4-cubic yard Bucyrus Erie electric shovel, which loads four B83 Mack 20-ton trucks. The quarry is worked by a single 50-foot lift that is drilled on an 18- by 21-foot pattern by a Model 735 BH Joy rotary drill drilling 6¾-inch holes. Stone is loaded by an 8-cubic yard Bucyrus Erie electric shovel. A 5-cubic yard shovel is on standby duty. Haulage is by three 50-ton Euclid trucks.

QUARRY CRUSHING PLANT

The primary crusher is a 42-inch Allis-Chalmers gyratory crusher. Hang ups are handled by a hobgoblin hydraulically operated breaker point. Some secondary blasting is required. The crusher product is discharged on a 60- by 48-inch Jeffrey feeder feeding a 42-inch conveyor, which carries the stone to the secondary crusher building. The conveyor discharges on two Nordberg 5- by 5-foot vibrating 4-inch bar grizzlies. The oversize goes to two secondary crushers, Allis-Chalmers 20-inch gyratories. The discharge from these crushers goes to a 5½-foot Symons standard cone. The throughs from the grizzlies, together with the crusher products, go to the Hydrocone crusher building.

At the Hydrocrone building the stone is discharged on a 6- by 12-foot, 2-deck, Simplicity scalping screen. The top deck has 4-inch round openings, and the bottom deck has 2½-inch openings. The oversize from both decks feeds via transfer conveyor to a 12- by 60-inch Allis-Chalmers Hydrocone crusher. The minus 2½-inch stone (throughs from the scalper) goes to a Tyler 3-deck, 5- by 14-foot, F800 screen. The top deck has 1½-inch openings; the middle deck has 1-inch square openings; and the lower deck has 3/16-inch by 1¼-inch openings. The throughs (screenings) are conveyed to a hopper and stockpiled. The plus 1½-inch stone is fed to two 250-ton bins for metallurgical stone. The minus 1½-inch by 1-inch stone and the minus 1-inch by 3/16-inch stone is fed to a surge pile east of the Hydrocone building for further crushing, screening, and washing.

The stone from the F800, 3-deck, 5- by 14-foot screen can either be fed to the RC2 36-inch conveyor that feeds the rock surge pile south of the Hydrocone building, or east to a stacker conveyor to a surge pile for the stone going to the Steetley kiln.

The product of the Hydrocone crusher also goes to the 36-inch conveyor (RC2) and to the surge pile south of the Hydrocone building. The stacker conveyor is a 36-inch, Barber-Greene, radial stacker.

Stone from the south surge pile feeds via a 42- by 48-inch Syntron feeder onto a 36-inch reclaiming conveyor in a tunnel below the surge piles. This conveyor discharges to a 200-ton loading bin, which serves the electric trains hauling stone to the screening and recrushing plant, 2½ miles to the south, on the brow of the Escarpment at Dundas. The three electric trains used for the haulage consist of three to four Easton side-dumping tandem cars carrying about 30 tons each.

SCREENING AND RECRUSHING PLANT

The screening and recrushing plant is described by Hewitt (1960, p.108-110). One line of trommel screens has been replaced by six 2-deck screens. Another 3-foot Symons standard cone has been added in the recrushing department.

The main products are now 2¾- by 1¾-inch blast furnace flux; 1¾- by 1-inch and 1-inch by ½-inch commercial stone; ½- by 3/16-inch chips; agricultural lime and screenings.

WASH PLANT AND CHEMICAL STONE

The chemical stone from the surge pile east of the Hydrocone building is recrushed, sized, and washed for feed to the dead-burned dolomite refractory kiln of Steetley Industries Limited.

A 24-inch conveyor in a reclaiming tunnel below the surge pile feeds the wash plant crusher, a Symons 4-foot shorthead cone. The product from this crusher is taken by a 24-inch conveyor to the screening and wash house where it passes over two Tyroc 2-deck, 5- by 12-foot screens with ½-inch openings in the top deck, and five mesh openings in the lower deck.

The plus ½-inch stone is returned to the 4-foot Symons shorthead cone for recrushing. The ½-inch by ⅛-inch stone from the bottom deck is split into two parts, each part going to a washing screen. These are two 6- by 14-foot F880 Tyler double screens with 5/16-inch and ⅛-inch openings. The plus ⅛-inch products of both screens go via 24-inch conveyor to the Steetley plant.

The throughs from the washing screens and the screenings from the primary screen, go to an Akins classifier for dewatering. The sand-sized product is stockpiled by stacker conveyor. The overflow goes to settling ponds. This plant has a production of about 100 tons of kiln stone and 25 tons of sand per hour.

Canadian Gypsum Company Limited (25)

GUELPH QUARRY AND LIME PLANT

The Guelph quarry and lime plant of Canadian Gypsum Company Limited are described by Hewitt (1960, p.124; 1964, p.55, 57).

J. S. Cook Quarry (32)

WIARTON

The Cook quarry on the north side of the Oliphant Road, 2.2 miles west of Wiarton, has been operated for over 60 years. From 3 to 6 feet of light buff to brown, thin- to medium-bedded, aphanitic Eramosa Dolomite is quarried. Beds range from 2 to 12 inches in thickness. Portable electric diamond saws are used to cut the stone in place. The stone is also cut by chisel and hammer, or by plug and feather. Coursing stone, flagstone, sills, steps, and rubble are produced.

A. Cope and Sons Limited (33)

STONEY CREEK

The plant and old quarry of A. Cope and Sons Limited is located on the top of the Niagara Escarpment, in lots 27 and 28, concession VI, Saltfleet Township, Wentworth County, south of Stoney Creek and west of Highway 20. The new quarry of A. Cope and Sons is east of the old quarry in lots 25 and 26, concession VI.

GEOLOGY

There is up to 12 feet of overburden overlying the Lockport Dolomite. The quarry section consists of 25 to 40 feet of medium brownish grey to light brown, aphanitic to medium crystalline, thin- to medium- and thick-bedded dolomite belonging to the Eramosa Member of the Lockport Formation. There is some colour banding in the beds, and shaly partings. Spots of white calcite and gypsum were noted together with rare pyrite and sphalerite. There is some gypsum in $\frac{1}{16}$-inch seams on bedding planes. The stone is relatively hard, having an average Los Angeles abrasion loss of 22 percent.

In the new quarry as in the old, the floor is shaly dolomite of the Vinemount Shale unit (Hewitt 1960, p.103). In January 1961, a drill hole was put down in the old quarry floor. The stratigraphic log of this hole is as follows: 0–14 feet, Vinemount shaly dolomite; 14–38 feet, brown Lockport Dolomite; 38–55 feet, Ancaster chert beds; 55–60 feet, Gasport Limestone; 60–65 feet, DeCew Dolomite; 65–97 feet, Rochester shaly dolomite and shale.

Chemical analyses of dolomite samples from a drill hole in the quarry face are given in Table 81.

QUARRY OPERATION

Overburden is up to 12 feet thick at the east end of the quarry. The quarry face, which is up to 40 feet in height, is drilled by a Joy Ram 450 ADR track drill, drilling 3-inch holes on a 9- by 9-foot pattern. The blasting agents are dynamite and prilled ammonium nitrate.

Stone is loaded by a $2\frac{1}{2}$-cubic yard Northwest model 80D diesel shovel. Haulage to the primary crusher is by three 22-ton Euclid rear-dump trucks. A grizzly precedes the primary crusher, which is a 43- by 50-inch Cedarapids double impact breaker. A 36-inch conveyor carries the stone from the impact breaker to a 5- by 10-foot Tyroc 3-deck screen with $2\frac{1}{2}$-inch, $1\frac{1}{4}$-inch, and $\frac{3}{4}$-inch openings. The plus $2\frac{1}{2}$-inch stone goes to a 4-foot Symons standard cone and then via the No. 2, 30-inch conveyor to a screen tower. The $2\frac{1}{2}$- by $1\frac{1}{4}$-inch stone goes to a 4-foot Symons shorthead cone crusher, and the product goes by conveyor to the 30-inch No. 2 con-

Table 81 — CHEMICAL ANALYSES — A. COPE AND SONS LIMITED
ANALYSES (IN PERCENT) BY MINERAL AND RESEARCH BRANCH, ONTARIO DIVISION OF MINES, 1968

SAMPLE NO.	DEPTH FROM SURFACE FEET	COMPONENTS IN PERCENT							
		SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	CO_2	S	TOTAL
1	0–5	1.97	2.02	0.58	20.7	28.7	44.4	0.03	98.4
2	5–10	1.07	0.91	0.38	20.7	28.7	45.6	0.03	97.4
3	10–15	1.26	1.34	0.48	21.7	27.9	44.8	0.12	97.6
4	15–20	1.06	0.86	0.45	21.5	27.6	45.7	0.05	97.2
5	20–25	1.64	0.50	0.48	21.3	27.9	44.4	0.14	96.4
6	25–30	1.86	1.19	0.53	21.3	27.9	43.0	0.26	96.0
7	30–35	4.12	1.87	0.82	20.7	26.6	43.4	0.37	97.9

veyor to the screen tower. A hopper and conveyor is arranged to feed a 4-foot Symons shorthead cone crusher for recrushing. The 1¼- by ¾-inch stone goes to a bin and the ¾-inch throughs to a second bin for ¾-inch crusher run.

The stone carried by No. 2 conveyor to the screen tower discharges on a 5- by 12-foot Dillon 2-deck screen and then to two 4- by 12-foot, 3-deck screens in parallel. These screens produce 1½-inch, ¾-inch, ½-inch, ⅜-inch, ¼-inch stone, and screenings.

The plant has a capacity of 300 tons per hour. Haulage is by truck. Most of the stone is used in road construction, asphalt concrete, and concrete aggregate.

Domtar Chemicals Limited (44)

GLENCHRISTIE QUARRY AND LIME PLANT

The Glenchristie quarry and lime plant of Domtar Chemicals Limited is described by Hewitt (1960, p.123-124; 1964, p.57). The stone quarried is Guelph Dolomite of high purity.

Dufferin Materials and Construction Limited (46)

DUFFERIN QUARRY

The quarry and plant of the Dufferin quarry are described by Hewitt (1964, p.51-52) under the name Associated Quarries and Construction Limited.

Some minor modifications have been made in the quarry operation. Drilling is done on a 20- by 20-foot pattern by a Joy 735-BH Champion blast hole drill, drilling a 7⅜-inch hole. Stone is loaded by two Caterpillar model 988 6-cubic yard loaders, and one 3-cubic yard Koehring diesel shovel. Haulage to the primary crusher is by three 35-ton and two 25-ton rear dump trucks.

In the crushing and screening plant, a 3-foot standard cone has been put in tandem with the 4-foot shorthead cone.

Ebel Quarries (48)

WIARTON

Ebel Quarries on the south side of the Oliphant Road, 1.8 miles west of Wiarton, in lots 6 and 7, concession XXIV, Amabel Township, Bruce County, are described by Hewitt (1964, p.58).

James D. Gray and Son Ltd. (53)

FLAMBORO QUARRY

The Flamboro quarry of James D. Gray and Son is located in lot 6, concession IV, West Flamborough Township, on the west side of the Brock Road.

The quarry is described by Hewitt (1960, p.111; 1964, p.45). Some modifications have subsequently been made. The 20-foot quarry face is now drilled on a 12- by 16-foot pattern. Primary crushing is done by a 15- by 32-inch Telsmith jaw crusher. The product goes to a Telsmith 3-deck 4- by 10-foot screen. The oversize goes to a Telsmith 3-foot cone crusher.

Indusim Limited (57)

ACTON QUARRY

One of the largest limestone quarries in Ontario was opened near Acton in 1963 by Acton Limestone Quarries Limited at the old Dolly Varden quarry property in lots 23 and 24, concession IV, Esquesing Township, Halton County. The company was taken over by Indusmin Limited in 1967. The quarry property is on the brow of the Niagara Escarpment a mile east of Acton and 1½ miles west of Limehouse. The Canadian National Railways line passes the property and a siding has been built. It is approximately 34 miles by rail to the Union Station in Toronto. Until 1930 the quarry was worked for the production of dolomitic lime by the Toronto Lime Company. The company has rail stone-depots in the Toronto area in Scarborough and at Concord.

GEOLOGY

The 65-foot quarry face is composed entirely of Amabel Dolomite. It is light buff to light grey in colour, buff weathering, medium to coarsely crystalline, medium to thick and irregularly bedded, in part porous, highly fossiliferous, crinoidal.

The Reynales Dolomite, which underlies the Amabel Formation, is exposed in a roadcut a few feet below the present quarry floor. The Reynales Dolomite is 8 feet thick, light buff to greenish grey in colour, buff weathering, medium to thick bedded and aphanitic in texture. The Reynales Dolomite is underlain by about 10 feet of green shale and shaly dolomite of the Cabot Head Formation. A few feet of red Grimsby Shale equivalent are exposed below the green shale.

Table 82 | CHEMICAL ANALYSIS — INDUSMIN LIMITED, ACTON QUARRY

	COMPONENTS IN PERCENT								
	SiO_2	Fe_2O_3	Al_2O_3	$Ca_3(PO_4)_2$	CaO	MgO	L.O.I.	SO_3	TOTAL
A	0.48	0.51	0.27	0.02	31.12	20.50	46.80	0.02	99.72
B	0.10	0.24	2.20	...	30.05	20.42	47.08	0.09	100.18

Two chemical analyses of stone from the quarry are given in Table 82. 'A' is an analysis given by Goudge (1938, p.242) of a sample representative of a 35-foot thickness of the dolomite quarried by Toronto Lime Company. 'B' is an analysis of 1-inch stone taken by the author from the stockpile.

QUARRY AND PLANT OPERATION

The quarry face has been opened over a length of 1,800 feet along the Escarpment. The rock surface is irregular and overburden varies from zero to about 20 feet in thickness. Stripping is carried out by a 2½-cubic yard backhoe and a front-end loader. A Gradall cleans the rock surface. Haulage of overburden is by 35-ton dump trucks.

Ten-inch holes are drilled on a 25- by 25-foot pattern by a Bucyrus-Erie 50R rotary drill. Stone is loaded by a 7-cubic yard P & H electric shovel into two 50-ton Euclid rear dump trucks for haulage to the primary crusher, a 54-inch Allis Chalmers gyratory. Oversize blocks that require secondary blasting are removed from the gyratory crusher by a 20-ton grapple.

The product from the primary crusher is minus 7-inch stone that is fed by a 2,000 t.p.h. feeder to a 54-inch conveyor, No. 1, that stockpiles the stone in a 50,000 ton surge pile. This stone goes by conveyors Nos. 2 and 3 to the secondary crusher house where a 5- by 14-foot scalping screen separates the plus 4-inch stone that goes to the secondary crusher, a Telsmith gyratory set at 1½ inches.

The product from the secondary crusher goes via 36-inch conveyor, No. 4, to a Telsmith single deck 6- by 16-foot screen with 1½-inch openings. This screen is in the tertiary crusher house that houses two Telsmith FC66 gyratory crushers set at $1\frac{1}{16}$ inch. The plus 1½-inch stone from this screen goes to one of the tertiary crushers. The minus 1½-inch stone goes via conveyors Nos. 10 and 11 to No. 1 screen tower.

The minus 4-inch stone from the scalping screen goes via conveyor No. 5 to a 2-deck 6- by 16-foot screen in the tertiary crusher house. This screen has ⅞-inch and $\frac{5}{16}$-inch decks. The plus ⅞-inch stone goes to the teritiary gyratory crusher. Both the tertiary crushers are over conveyor No. 10 and the crusher products go via conveyors Nos. 10 and 11 to No. 1 screen tower. The minus 1½-inch plus ¾-inch stone goes via conveyors Nos. 10 and 11 to the screen tower. The minus ⅞-inch stone goes via conveyors No. 7 and 8 to stockpiles for ¾-inch crusher run and granular B.

At screen tower No. 1 the feed is split to two 3-deck 6- by 16-foot screens with 2-inch, ⅞-inch, and $\frac{5}{16}$-inch decks. The plus 2-inch stone is returned to the tertiary crusher building for recrushing. The minus 2-inch plus ⅞-inch stone is stockpiled by stacker conveyor. The minus $\frac{5}{16}$-inch screenings are also stockpiled. Two 200-ton bins for these products are also located at the screen tower. The minus ⅞-inch stone goes to screen tower No. 2.

At screen tower No. 2 the split feed goes to the 2-deck 6- by 16-foot screen with ⅝-inch and ½-inch decks. The minus ⅞- plus ⅝-inch stone goes to a stockpile. The minus ⅝- plus ½-inch stone goes to a stockpile. Two 200-ton bins for these products are located at the screen tower. The minus ½-inch stone goes to screen tower No. 3.

At No. 3 screen tower the feed is split to two single-deck 6- by 16-foot screens with ¼-inch cloth. The minus ⅜- plus ¼-inch stone goes to one stockpile whereas 50 percent of the minus ¼-inch screenings go to another stockpile. Two 200-ton bins for these products are also located at the screen tower. These bins at the screen towers are for truck loading of sized stone. The remaining 50 percent of the ¼-inch screenings are separated at a $\frac{3}{16}$-inch screen into ¼-inch chips and $\frac{3}{16}$-inch screenings.

A 42-inch reclaiming conveyor is installed in the reclaiming tunnel under the six 50,000-ton stockpiles. The belt is fed by two Syntron feeders under each stockpile. Stone can be blended as desired by automatic electronic controls. The blended stone is conveyed from the reclaiming tunnel by an incline conveyor to a 36-foot shuttle conveyor over four 400-ton blending bins on the railway siding.

Plant capacity is approximately 1,000 tons per hour. Provision has been made in planning to double this capacity if required. The crushing and screening plant is completely automated. Washing is carried out.

Indusmin Limited (58)

HALTON QUARRY

In 1970 Indusmin Limited acquired the property of Halton Crushed Stone Limited. The Halton quarry and plant have been described by Hewitt (1960, p.120-121; 1964, p.48-49). The quarry is located on top of the Niagara Escarpment, 4 miles west of Milton, in lot 8, concession VI, Nassagaweya Township, Halton County. This quarry began operations in the summer of 1959.

GEOLOGY

Grey-green Cabot Head Shale is exposed in ditches in the quarry floor. This is overlain by 8 feet of Reynales Dolomite. Four feet of Reynales was observed in the ditch and four feet in the base of the quarry face. Above the Reynales is up to 86 feet of Amabel Dolomite. At the present time, due to relief of the rock surface, the maximum quarry face is about 75 feet.

The lower 10 to 12 feet of the Amabel Dolomite is grey and buff banded medium-crystalline crinoidal dolomite. This steaky grey facies of the Amabel Dolomite may be the Gasport equivalent. Above this the dolomite is buff to light grey in colour, buff weathering, medium crystalline, crinoidal, medium to thick and irregularly bedded, reefy, stylolitic, and fossiliferous.

The geologic section is described in Table 83.

Two chemical analyses of the stone from the Halton quarry are given in Table 84. The first was supplied by the company. The second is a sample of ¾-inch stone from the stockpile taken by the author.

QUARRY OPERATION

Overburden in the quarry area ranges from a few inches to 20 feet in thickness. The quarry is operated in a single lift. A Joy Heavyweight Champion drill drills 7⅞-inch holes on an 18- by 17-foot pattern. Stone is loaded by a Michigan 275, 6½-cubic yard front-end loader. Haulage is by one 35-ton and two 27-ton Euclid rear-dump trucks.

The stone is dumped on a 43-inch by 14-foot feeder, which feeds a double vibrating grizzly that removes minus 2-inch fines and any dirt from the quarry stone. The oversize from the grizzly feeds a 40- by 50-inch Cedarapids impact mill. The product from the crusher goes to a 4- by 12-foot 2-deck scalping screen. Crusher run is extracted and stockpiled by stacker conveyor. The plus 2¼-inch stone goes to the

Table 83 | GEOLOGIC SECTION — INDUSMIN LIMITED, HALTON QUARRY

UNIT	DESCRIPTION	THICKNESS FEET
Amable Dolomite		
4	Dolomite: buff to light grey, buff weathering; medium crystalline; crinoidal; medium to thick and irregularly bedded; reefy in part; stylolitic, highly fossiliferous	76.0+
3	Dolomite: grey and buff banded, grey weathering; medium crystalline; crinoidal; medium to thick bedded; fossiliferous	10.0
Reynales Dolomite		
2	Dolomite: grey to buff, mottled; aphanitic; medium bedded; dense	8.0
Thorold Shale		
1	Shale: grey-green; fissile	2.0+

Table 84 | CHEMICAL ANALYSES — INDUSMIN LIMITED, HALTON QUARRY

	COMPONENTS IN PERCENT							
	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	S	CO_2	TOTAL
1	0.59	0.04	0.46	31.08	20.59	0.04	46.88	99.68
2	0.16	0.69	0.33	30.28	21.02	...	47.22	99.70

surge pile that feeds the secondary crushing and screening plant.

The secondary crushing plant has a 4¼-foot Symons standard cone and a 4¼-foot short head cone crusher. Sized products as required are produced on two screen lines, each consisting of one 4- by 12-foot 2-deck screen and one 4- by 14-foot 2-deck screen. Sized products from these two sets of screens go to seven steel bins. Provision is made for blending and recrushing.

E. C. King Limited (60)

OWEN SOUND

A quarry is operated by E. C. King on lot 25, concession II, S.C.R., Sydenham Township, Grey County, 4 miles east of Owen Sound.

Weathered bedrock outcrops of Amabel Dolomite are prominent in the irregular surface of the quarry property. In the quarry face the top 10 feet consist of weathered dolomite, boulders, and clay. The face is up to 38 feet high. It exposes light to very light grey, medium- to massive-bedded, fine-crystalline, reefy dolomite. The dolomite is porous and vuggy; vugs are lined with calcite or, in extremely vuggy sections of the face, filled with reddish brown clay; there is a colour variation from the usual very light grey dolomite with light grey to bluish grey streaks to areas of predominantly bluish to medium grey dolomite.

A chemical analysis of a chip sample of the quarry face is given in Table 85.

QUARRY OPERATION

Drilling of 4¼-inch holes is done by Ingersoll-Rand Air Trac drill. The drill pattern is 12 by 12 feet.

A 1½-cubic yard, Model 98, Linkbelt shovel loads stone at the face. Large blocks are broken by a 3-ton drop ball mounted on a shovel. Stone is trucked to a primary Barber-Greene jaw breaker that crushes to minus 6-inch size. A 2-deck scalping screen takes out two sizes of stone. Plus 4-inch or plus 2-inch stone, depending on which screen is used, is recrushed in the primary crusher. Minus 2-inch stone is crushed in a secondary 4-foot cone crusher. The product of this crusher goes to a 3-deck Barber-Greene screen for sizing.

Fifteen company owned 25- and 15-ton trucks transport aggregate to job sites in the area. They are loaded from stockpiles by a Caterpillar, Model 988, front-end loader. A Weir 50-ton weighscale of 38-foot length is installed at the entrance of the quarry.

McKean Quarry (73)

Collingwood Sand and Gravel Limited

DUNTROON

The McKean quarry, 2 miles west of Duntroon in Nottawasaga Township, Simcoe County, is described by Hewitt (1964, p.57-58).

The quarry continues operating a 40-foot face in white to light buff, porous, fossiliferous Amabel Dolomite. There is another 35 feet of similar dolomite available below the floor of the quarry, according to the quarry manager. The dolomite shows near horizontal bedding and is predominantly fine crystalline, massive bedded and reefy.

Two Gardner-Denver Air Trac drills drill 2¾-inch holes in a 6- by 7-foot pattern.

A Bucyrus-Erie 1¼-cubic yard shovel loads stone at the face. Two 18-ton Euclid trucks haul stone to the primary crusher, a Cedarapids Impeller. The crushed product passes over a scalping screen. Oversizes are directed to a Cedarapids Junior Crusher. Sizing of crushed products is done on a 3-deck screen producing ¾-inch stone, ⅜-inch stone, and dust. Products are retrieved by truck from three loading bins. Two 22-ton hopper trucks, one 16-ton tandem truck, and a 10-ton truck are operated by the company. Products are 2-inch, ¾-inch, ⅜-inch stone, screenings, and 4-inch crusher run.

A Weir scale with a capacity of 50 tons is installed at the entrance of the quarry property. Additional equipment operated in the quarry includes a drop ball mounted on a Koehring shovel boom, a 1½-cubic yard Massey-Ferguson front-end loader, and an International Bulldozer.

Table 85 — CHEMICAL ANALYSIS — KING QUARRY, OWEN SOUND

COMPONENTS IN PERCENT							
SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	L.O.I.	TOTAL	CO_2
0.31	0.96	0.52	21.4	30.4	47.0	100.59	46.0

Table 86 | QUARRY SECTION – MacLACHLAN QUARRY, BEAMSVILLE

UNIT	DESCRIPTION	THICKNESS FEET
Eramosa Dolomite		
MB2	Dolomite: brown to brownish grey; fine crystalline to aphanitic, sugary texture; medium bedded; bituminous shaly parting with rusty weathering in places; black colour banding in part; minor vugs, some filled with calcite or galena; from 16.8 to 19.8 feet uneven bedding due to small bioherms; stylolites at 25.8 feet	24.3
MB1	Dolomite: medium to brownish grey, mottled; aphanitic; massive to medium bedded; cubical fracture; calcite-filled vugs; lower 2.5 feet not exposed	6.0
	Total	30.3

Table 87 | CHEMICAL ANALYSIS – MacLACHLAN QUARRY, BEAMSVILLE

COMPONENTS IN PERCENT							
SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	L.O.I.	TOTAL	CO_2
1.40	0.96	0.52	20.5	29.5	46.4	99.28	45.0

MacLachlan Quarry (76)

BEAMSVILLE

In April 1969 Aiken and MacLachlan of St. Catharines opened a quarry in Clinton Township, Lincoln County. The quarry is located on lot 20, concession IX, 4 miles south of Beamsville and ½ mile west of the Beamsville Road. It is presently owned and operated by King Paving and Materials Limited.

When visited in September 1970 the quarry was producing crushed stone at a rate of about 1,000 tons per day from a 30-foot quarry face in Eramosa Dolomite.

The quarry face at that time was worked in two lifts but plans called for a revision of procedures after a sufficiently large area of quarry floor would become available for relocation of equipment. Surface strippings were being stockpiled on the property.

A description of the quarry face is given in Table 86.

A chemical analysis of a sample of ¾-inch crushed stone from the stockpile is given in Table 87.

QUARRY OPERATION

A Joy air track drill was used to drill 2½-inch holes in a 4½- by 4½-foot pattern for the upper lift and a 5- by 5-foot pattern for the lower lift.

Rock was loaded at the face by a 6-cubic yard Hough front-end loader that made a 400-foot round trip up the ramp to the primary crusher, a portable Cedarapids 30-inch impact crusher with grizzly. Crushed stone was conveyed to a surge pile by a 36-inch conveyor belt. From the surge pile rock passed over a scalper screen taking out the minus ¾-inch material. A secondary Hallam cone crusher produced minus 2-inch crushed stone from the oversize which then passed over the scalper screen again. Minus ¾-inch material proceeded from here to a permanent Cedarapids double-deck 4- by 11-foot screen to produce ¾-inch, ⅝-inch, ⅜-inch, and ¼-inch crushed stone, and dust, whereas oversizes returned to the secondary crusher. Screened sizes were stored in six hoppers of 100-ton capacity each. A blending conveyor underneath these hoppers allowed for blending of aggregate according to demand.

Two Michigan front-end loaders of 3- and 4-cubic yards respectively were available for use on stockpiles and for general use. Two Caterpillar bulldozers (Model D6 and D8) were used for stripping and cleaning. One Adams grader, one International single-axle dump truck, and two Ford tandem diesels of 15- and 16-ton capacity respectively complete the list of equipment used in production.

Milton Quarries Limited (78)

MILTON

The quarry and plant of Milton Quarries Limited are described by Hewitt (1960, p.119; 1964, p.47).

Some modifications have been made since the 1964 report. Overburden is stripped by Gradall. Haulage is by two Terex trucks with 27- and 35-ton capacities.

Nelson Crushed Stone (79)

Division of

King Paving and Materials Limited

One of the largest limestone quarries in Ontario is operated in Nelson Township (Town of Burlington) by Nelson Crushed Stone, a division of King Paving and Materials Limited. The quarry and plant are described by Hewitt (1960, p.113-118).

Some modifications have since been made. Six and three-quarter inch holes are drilled by a Gardner Denver 30 RDC drill on an 18- by 22-foot pattern. Stone is loaded by a P & H 1600 7-cubic yard electric shovel. Haulage is by three 35-ton Wabco Haulpac trucks and two 27-ton Euclid trucks.

Stripping is done by 2 backhoes; belly dump trucks are used for haulage of stripping.

Owen Sound Ledgerock Limited (81)

OWEN SOUND QUARRY

The Cruickshank quarry of Owen Sound Ledgerock Limited is in lot 17, concession IV, Keppel Township, Grey County, about 7 miles northwest of Owen Sound. The quarry face of 18 inches to 2 feet in height exposes medium grey-brown, thin-bedded, aphanitic, banded Eramosa Dolomite. The beds are from ¾ inch to 2¼ inches thick. A portable 14- to 18-inch diameter diamond saw is used to cut the stone into blocks measuring several feet square, which are removed from the quarry by bars and wedges and by a fork-lift truck.

The stone is cut by saw or guillotine. The main production is random flagstone, coursing, wallflag, copings, sills, and mantles.

Owen Sound Ledgerock Limited (82)

WIARTON QUARRY

The Wiarton quarry of Owen Sound Ledgerock Limited is on the south side of the Oliphant Road, 3 miles west of Wiarton. Two to three feet of medium to dark brown, buff weathering, thin-bedded, aphanitic Eramosa Dolomite are quarried. Beds range from 1 inch to 8 inches in thickness. Stone is quarried by portable 14- to 18-inch diamond saws. Ashlar, flagstone, sills, and steps are the principal products. A guillotine is used for splitting ashlar coursing stone.

Queenston Quarries Division (87)

Steetley Industries Limited

The quarry and plants of the Queenston Quarries Division of Steetley Industries Limited are described by Hewitt (1960, p.91-94; 1964, p.43). In 1969 drill holes in the quarry floor disclosed from 63 to 69 feet of Rochester Shale, 12 to 13 feet of Irondequoit Limestone, 9 feet of Reynales Dolomite, and a few feet of Neagha Shale.

Drilling of the aggregate ledge is done by a Joy TM450 drill, drilling 2¾-inch holes on a 7- by 8-foot pattern. Stone is loaded by a Bucyrus-Erie 2½-cubic yard electric shovel loading 20-ton Mack rear-dump trucks. At the secondary crusher building the secondary crushing is now done by a 30-inch by 30-inch Cedarapids double impeller impact crusher.

St. Catharines Crushed Stone Limited (92)

The quarry and plant of St. Catharines Crushed Stone Limited are described by Hewitt (1960, p.97-98; 1964, p.43). A 3-foot Symons standard cone has been added to recrush plus 2⅝-inch stone. The product goes to the main conveyor line for screening.

Vineland Quarries and Crushed Stone Limited (99)

VINELAND QUARRY

The Vineland quarry of Vineland Quarries and Crushed Stone Limited is described by Hewitt (1960, p.98-99). Overburden now ranges up to 22 feet in thickness. An earth berm has been constructed along the south side of the quarry along the road and trees have been planted on the berm. This effectively screens the quarry operation from the road.

A single face ranging from 28 to 32 feet in height is drilled by a Joy Ram RR500 track drill on an 8- by 8-foot pattern. Stone is loaded by two Northwest shovels of 1½-cubic yard and 2-cubic

yard capacities. Haulage is by three 22-ton Euclid trucks.

The primary crusher is a 32- by 40-inch Buchanan jaw crusher. The crushed product goes to a Tyroc 4- by 8-foot 2-deck screen with 2½-inch and ⅞-inch openings. Secondary crushing is done by a Cedarapids 30-inch by 30-inch impact crusher. Some recrushing is done by a Joy Hazemag C200 impact crusher. A full range of products is produced by screening and washing. Plant capacity has been increased to 300 to 350 tons per hour.

Walker Brothers Quarries (100)

THOROLD

The quarry of Walker Brothers Quarries is located on the brow of the Niagara Escarpment, 1 mile east of Thorold, in lots 21 and 22, concession X, Stamford Township, Welland County.

The geology and quarry section are described by Hewitt (1960, p.94-95). The plant was rebuilt in 1965 and the new plant is described below.

QUARRY OPERATION

From 10 to 35 feet of clay overburden is stripped by a 505 Koehring Scooper that is equipped with a backhoe when required. Drilling of the 30- to 40-foot face is done by a Gardner Denver PR 123J drill with a 3-inch bit. Air is supplied by an SP600D compressor. The pattern is 9 by 11 feet. The blasting agent is prilled ammonium nitrate. The stone is loaded by 4½-cubic yard Marion model III M electric shovel. Haulage is by three 30-ton Wabco rear-dump trucks. A 4½-cubic yard front-end loader is on standby duty in the quarry.

CRUSHING AND SCREENING

The trucks dump the quarry stone into a hopper over a Traylor apron feeder that feeds a 4860 Allis Chalmers jaw crusher set at 9 inches. The product goes via conveyor to a 5- by 10-foot scalping screen with 8-inch square openings. The plus 8-inch rubble goes to a 50-ton rubble bin for mansized rubble stone.

Minus 8-inch stone goes to a 5- by 10-foot double-deck F660 Tyler screen with 2-inch and ⅞-inch openings. The plus 2-inch stone goes to the secondary crusher, a 5½-foot Symons standard cone. The minus 2-inch and minus ⅞-inch stone can go either to a bin for "traffic bound" stone, or via conveyor No. 3 to a surge pile.

From the surge pile the stone is conveyed to a screening tower equipped with two lines of three double-deck screens and two tertiary cone crushers. The stone discharges on two 5- by 12-foot F600 Tyler screens with 2-inch and 1½-inch openings. The oversize from the 2-inch screens goes either to a bin or to a 4¼-foot standard Symons cone crusher for recrushing. The plus 1½-inch stone from the lower decks goes to two bins for 1½-inch stone. The minus 1½-inch stone goes to a pair of double-deck 5- by 14-foot screens with $1\frac{3}{16}$-inch and ½-inch openings. The oversize fractions are chuted into bins for 1-inch and ½-inch stone and the throughs are conveyed to a pair of 6- by 16-foot Tyler F800 screens with ¼-inch openings in the upper decks and ⅛-inch and $\frac{3}{16}$-inch openings in the lower decks. The oversize from the ¼-inch screens goes to ¼-inch stone bins. The oversize and undersize from the lower screens are screenings and agricultural limestone.

Recrushing may also be done by a 4-foot short head Symons cone crusher. The stone may be blended as desired from the product bins and loaded into two 80-ton blended product bins. Plant capacity is approximately 550 tons per hour.

Bois Blanc Limestone and Bertie Dolomite

The Devonian Bois Blanc Cherty Limestone and the underlying Silurian Bertie Dolomite are quarried commercially by nine operators in the Fort Erie-Port Colborne-Hagersville area. One of the quarries, Jarvis Crushed Stone Limited, quarries only the Bois Blanc cherty limestone. The other eight operators, Geo. C. Campbell Company, Cayuga Materials and Construction Limited, Dufferin Materials and Construction Company (Hagersville Quarry), Dunnville Rock Products, Haldimand Quarries and Construction Limited, R. E. Law Crushed Stone Limited, Port Colborne Quarries Limited, and Ridgemount Quarries Limited, quarry both the Bois Blanc cherty limestone and the underlying Berite Dolomite. These formations will therefore be dealt with together.

The Bertie Dolomite and overlying Bois Blanc Limestone form a south- and southwest-dipping band of bedrock, 4 to 12 miles wide, extending from Fort Erie through Port Colborne, Hagersville, Woodstock, Listowel, Palmerston, and Walkerton to Port Elgin on Lake Huron. There are at present no commercial quarry operations northwest of Hagersville in these formations.

BERTIE DOLOMITE

(Bass Islands Equivalent)

The Bertie Dolomite is the uppermost formation of the Silurian System in the Niagara Peninsula, and rests on the underlying Salina shale and shaly dolomite. The lower contact is not exposed in any quarries visited. There is an erosional unconformity between the Bertie Dolomite and the overlying Middle Devonian Bois Blanc cherty limestone, and a complete Bertie section is not generally present. The upper contact is exposed in several quarries. The Bertie Formation has a thickness of 35 to 60 feet. The dolomite forms a band, 1 mile to 2 miles wide, extending from Fort Erie west through Dunnville and Hagersville to Southampton on Lake Huron. It dips to the south or southwest.

The Bertie formation can be divided into four units: the lowermost unit is medium brown, massive- to medium-bedded, aphanitic dolomite, up to 20 feet thick; above this there is a dark greyish brown, thin-bedded, shaly dolomite unit 6 to 12 feet thick. This shaly unit is persistent and can be seen in each of the nine quarry sections. Above the shaly unit in the Fort Erie-Port Colborne area, the upper 12 to 18 feet consist of a lower massive to laminated, brown dolomite and an upper buff mottled, aphanitic dolomite. To the west, at Dunnville, Cayuga, and Hagersville, the two upper units consist of massive to mottled or laminated brown dolomite, overlain by light buff to laminated, buff, aphanitic dolomite.

The upper 10 to 20 feet of Bertie light buff dolomite contain thin sandy interbeds in many places, possibly indicating a change from chemical to clastic sedimentation in a shallowing sea before the advent of the epoch during which the Lower Devonian Oriskany beach sand was laid down. The Oriskany Sandstone and Springvale Sandstone Member of the Bois Blanc Formation may represent weathering and reworking of the sandy facies in the upper Bertie in this area.

BOIS BLANC LIMESTONE

The Bois Blanc Formation is of Middle Devonian age and rests unconformably on the Upper Silurian Bertie Dolomite. The Lower Devonian Oriskany Sandstone is absent through most of the area, being present only in Oneida and North Cayuga Townships near Nelles Corners. The Bois Blanc Formation extends in a band, 3 to 10 miles wide, extending from Fort Erie, through Hagersville and Woodstock to Port Elgin on Lake Huron. The thickness of the formation is 90 to 100 feet at Selkirk (south of Cayuga), 102 feet at Norwich, 125 feet at Ingersoll, 195 feet at St. Marys, and 240 feet at Teeswater, to 220 feet at Inverhuron. It thickens to the northwest.

The Bois Blanc Formation is present in all nine quarries examined in the Fort Erie-Hagersville area.

The Bois Blanc Formation consists mainly of medium brownish grey to greenish grey, light grey weathering, medium-crystalline, medium- to irregularly thin-bedded, highly fossiliferous, cherty limestone. The limestone may be silty, argillaceous, or sandy in places.

The basal member of the Bois Blanc Formation is in many places a greenish, glauconitic, sandy unit. The sandstone, known as the Springvale Sandstone Member, is not always present as a distinct unit, but in many places the lower few feet of Bois Blanc cherty silty limestone contains sandy, greenish, glauconitic beds. In places the glauconitic sandstone layers occur several feet above the lower Bois Blanc contact.

The Bois Blanc Limestone is extremely fossiliferous, with cup corals being unusually abundant. At the Canada Cement Company quarry at Port Colborne, the variable lithology of the Bois Blanc Limestone may be readily seen. Here, greyish green, silty to shaly, magnesian limestone appears on the southwest side of the quarry. This gives way to the normal cherty, thin to medium irregularly bedded, Bois Blanc Limestone. Coral biostromes, 6 to 8 feet thick and flatly lenticular in shape, form lenses of high-purity limestone in the quarry face.

At Hagersville four units are recognizable in the Bois Blanc Formation: a lower sandy, shaly, glauconitic, cherty, silty limestone, up to 6 feet thick; a lower cherty limestone member, 12 to 14 feet thick; a middle limestone member relatively chert-free, 6 to 12 feet thick; and an upper cherty limestone member, of which 12 to 13 feet is exposed in the quarries.

Some of the lower Bois Blanc Formation is nominally a limestone, but consists of chert beds 3 to 5 inches thick. At the Port Colborne Quarries, the silica content of the 9 feet of Bois Blanc Formation sampled by the author is 67.82 percent. Chert occurs both in layers and nodules and in many places replaces fossils.

George C. Campbell Company Limited (19)

STEVENSVILLE

The quarry and plant of George C. Campbell Company are described by Hewitt (1960, p.128-130; 1964, p.60-61). The quarry, located 2½ miles east of Stevensville, on lot 8, concession VIII, Bertie Township, Welland County, has extended south of the township road.

The quarry is operated in two lifts. The lower lift is 19 feet high and produces asphalt aggregate whereas the upper lift, with a variable height of 20 to 28 feet, including 9 feet of the cherty Bois Blanc

Formation at the south face, produces Granular "A" for road construction.

The face is drilled by two Gardner-Denver Air Trac drills. Two and one half inch holes are spaced 8- by 8 feet in the upper lift and 7- by 7 feet in the lower lift. The lower lift has recently been opened south of the township road.

Loading at the face is done by a 6-cubic yard Caterpillar, Model 988, front-end loader or by a 1½-cubic yard Northwest diesel shovel. Stone is hauled by three Euclid trucks of 15- and 18-ton capacity to the 30- by 42-inch jaw crusher. A 30-inch conveyor belt carries stone to a 3-deck 6- by 12-foot Barber Greene screen. Oversizes are crushed in a 4-foot Symons Standard Cone and screened on a 3-deck 4- by 12-foot Niagara screen. From this screen products may go to either a 3-foot or a 4-foot Symons Shorthead crusher in closed circuit with the Niagara screen or they are passed over a 4- by 14-foot Cedarapids horizontal screen. Oversize from the horizontal screen is recrushed in the 4-foot Shorthead crusher. Two-inch stone may be recrushed to ⅞-inch size or less according to demand. Four loading bins, two of 500-ton and two of 150- to 200-ton capacity respectively, have been installed. Products include HL 6, 5, and 3, Granular 'A', and dust, all used in road construction.

Cayuga Materials and Construction Company Limited (27)

CAYUGA

The Cayuga quarry, 3½ miles west of Cayuga, is described by Hewitt (1960, p.138-140). It is now operated by Cayuga Materials and Construction Company Limited.

Bois Blanc cherty limestone overlies Bertie Dolomite in the quarry face. Selective quarrying is applied. Cherty limestone is avoided in concrete aggregate. Oriskany Sandstone is quarried separately and sold for use in cement production. Four to six feet of shaly dolomite is stripped from the present quarry floor to prepare for mining twelve to fifteen feet of brown dolomite underneath. The brown dolomite was exposed in the original quarry face reported on in 1960.

GEOLOGY

A complete section of the east quarry face is given by Hewitt (1960, p.138, 139). Elsewhere on the property a test hole gave the following intersection here reproduced in condensed form courtesy of Cayuga Materials and Construction Company Limited (Table 88).

OPERATION

Several changes have come about in the operation of the quarry. The face is drilled with two Joy Air Trac drills, with Gardner-Denver compressors, drilling 4-inch holes.

Stone is loaded at the face by a 10-cubic yard Michigan front-end loader. It is hauled to the primary crusher by two 35-ton Terex trucks. A change to direct loading at the face of a mobile Cedarapids primary crusher, linked in elbow fashion to the permanent crushing and screening plant by two sections of conveyor belt, is impending.

Stone from the face is fed to a 4- by 10-foot vibrating grizzly. Minus ⅞-inch Granular 'A' is

Table 88 — SECTION ENCOUNTERED IN HOLE NO. 4 AT CAYUGA QUARRY; FROM CAYUGA MATERIALS AND CONSTRUCTION COMPANY LIMITED

	THICKNESS FEET
Limestone and Chert: medium grey to medium brownish grey; fine crystalline, medium bedded; in places irregular brown shaly parting; up to 20 percent nodulees of white and grey chert	5.7
Sandstone: calcareous, light grey, fine grained; in a few places shaly parting; pebbles of brown dolomite at base; 5 percent nodules of white chert and cherty sandstone	4.4
Dolomite: light brown to medium brownish grey; medium bedded; aphanitic; colour lamination; in a few places shaly parting	26.7
Dolomite: medium bluish grey; argillaceous; thin to medium bedded; aphanitic; dark grey shaly parting	8.3
Dolomite: brown to light brownish grey; aphanitic; minor shaly parting and stylolites	12.0
Dolomite: medium bluish grey; argillaceous; thin to medium bedded; aphanitic; black and buff green shaly parting; lower 5 feet contain interbedded buff grey shale and sulphates (gypsum, celestite) in seams or as vug filling	12.9
Total	70.0

taken out and stockpiled via stacker conveyor. Oversize goes to a 43- by 50-inch Cedarapids heavy duty impact breaker. Broken stone is conveyed to a surge pile via a 36-inch wide and 500-foot long conveyor with weigh scale. The surge pile has a capacity of 20,000 tons with 8,000 tons reclaimable. A reclaiming belt fed by three Syntron feeders runs through a 135- by 8-foot Amco metal tunnel underneath this pile.

From the surge pile stone is carried to a 5- by 16-foot double-deck Cedarapids screen where minus ⅝-inch is removed and stockpiled via stacker conveyor. Plus 1½-inch stone is carried to a 4¼-foot Symons cone crusher. Crushed rock combined with minus 1½-inch stone goes on a 30-inch 147-foot conveyor to a 4- by 12-foot triple-deck Donald screen. The bulk of plus 1-inch stone from this screen is recrushed in a 3-foot Symons Standard cone crusher and 18- by 30-inch Pioneer rolls and returned to the 30-inch wide conveyor belt in closed circuit. Minus 1-inch stone from the Donald screen is carried on a 24-inch conveyor belt to two 4- by 12-foot Dillon double-deck screens where a total of seven sizes are screened out and passed to storage bins.

Stone from the storage bins is reclaimed by a blending belt-conveyor that passes below the bin chutes to a stacker. An alternate 24-inch belt carries stone from the bin chutes to the washing plant where a Dillon 4- by 12-foot double-deck screen, fed by 900 gallons of water per minute, washes any required size. Stacking is done by 24-inch by 125-foot stacker conveyors. Blended products can be tested for size gradation in a laboratory on the property.

Impending installation of additional crushing equipment, three double-deck screens and four storage bins, is expected to raise the crushing capacity to 4,000 tons of rock per ten hour shift; a doubling of production will be obtainable.

Four 15-ton Euclid trucks and two 4½-cubic yard, Model 175, Michigan loaders are employed on stockpiles and loading of railroad cars. Railroad cars can also be loaded directly by the blending belt.

Aggregate is provided to a Seneca ready-mix concrete plant and a Cedarapids asphalt plant of 2¼-ton batch capacity on the property as well as to a Norval ready-mix concrete plant and another Cedarapids asphalt plant, of 2-ton batch capacity, located at Simcoe.

A fleet of company-owned transport trucks and road building equipment is employed in highway construction. The bulk of quarry products is consumed in these projects. Other uses of quarry products are as railroad ballast, agricultural lime, and silica sand.

Shipping of products by rail covers points as far west as Windsor and Sarnia. A yard for stockpiles with loading facilities is maintained in Chatham.

Dufferin Materials and Construction Limited (45)

HAGERSVILLE QUARRY

The quarries west of the junction of the Michigan Central and Canadian National railways at Hagersville are described by Hewitt (1960, p.144-146; 1964, p.64). In 1965 Dufferin Materials and Construction Limited acquired ownership of the quarries and plant. Quarries in lots 12 and 13, concession XIII, Walpole Township, Haldimand County have been operated by this company.

In 1971 selective quarrying was carried out in the Northwest Quarry. At the time of visiting, 26 feet of limestone and dolomite were exposed in a second lift below the previous quarry floor. The upper part of this section is cherty limestone, sandstone, and glauconitic shale of the base of the Bois Blanc Formation overlying light and medium brown dolomites of the Bertie Formation. Some erosion of the light brown dolomite took place before deposition of the Bois Blanc Limestone, causing a variation of 2 or 3 feet in relative thickness of these rock types in the quarry face. The section is described in Table 89.

Chemical analyses of chip samples of the quarry face are given in Table 90.

QUARRY OPERATION

Drilling in the Northwest Quarry is carried out with two Joy Air Trac drills, a Mustang, drilling 4½-inch holes, and a Ram, drilling 3½-inch holes. The pattern used for drilling of the upper 10 feet of the second lift is respectively 9 by 9 feet and 8 by 8 feet.

A 5½-cubic yard Caterpillar front-end loader is used to load stone at the face. Two 35-ton Euclid trucks haul stone to the primary crusher, which is equipped with a Hewitt-Robins scalping grizzly feeder. Minus 3-inch stone is scalped off; the remaining 85 to 90 percent stone goes to a 30-inch McCully gyratory crusher that can handle up to 350 tons per hour of minus 36-inch stone.

Treatment of the stone is unchanged since 1960 except for replacement of a 10-inch McCully gyratory crusher with a 4-foot Symons shorthead crusher. A 3-foot Symons standard cone crusher has been added for recrushing of the 2-inch and 1-inch stone. A blending conveyor is installed under all storage bins.

A Barber-Greene asphalt plant with a 200-ton per hour capacity is operated on the quarry property. Products of the quarry include crushed stone, railway ballast, and asphalt aggregate. It is anticipated that

Table 89 | QUARRY SECTION — DUFFERIN MATERIALS AND CONSTRUCTION LIMITED, NORTHWEST QUARRY

UNIT	DESCRIPTION	THICKNESS FEET
Bois Blanc Limestone		
	Limestone: light to medium grey; medium bedded; fine crystalline; chert nodules; cup corals; irregular shaly parting	2.8
	Sandstone: light grey; calcareous; thick bed; coquinoid at base; cup corals near top of bed	2.7
	Siltstone and Chert: light grey; calcareous; medium-bedded; fine-crystalline to aphanitic; sandy siltstone with irregular shaly parting; black and grey chert	3.5
	Siltstone and Shale: medium grey to medium brownish grey; thin- to medium-bedded; aphanitic to fine-crystalline; cherty siltstone; irregular beds, up to 0.3 feet thick, of green and black, glauconitic shale; variable thickness due to unconformity at base	3.0
Bertie Dolomite		
	Dolomite: light brown, light buff weathering; medium to thick bedded; aphanitic; colour lamination in a few places; lower 2 feet light buff; upper contact irregular eroded surface; variable thickness	11.0
	Dolomite: medium brown; medium bedded; aphanitic; colour lamination; 3 feet not exposed	5.5
	Section above water level	28.5

Table 90 | CHEMICAL ANALYSES — DUFFERIN MATERIALS AND CONSTRUCTION LIMITED, NORTHWEST QUARRY

FEET ABOVE WATER LEVEL	COMPONENTS IN PERCENT							
	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	L.O.I.	TOTAL	FREE SILICA
16.5–25.8	63.7	2.81	1.72	4.92	14.8	13.9	101.85	58.5
5.5–16.5	2.56	1.34	0.70	20.1	31.5	45.8	102.00	...

selective quarrying of the lower lift will permit production of concrete aggregate from Bertie Dolomite.

Dunnville Rock Products Limited (47)

DUNNVILLE

The quarry operation of Dunnville Rock Products Limited is described by Hewitt (1960, p.136-138). Deepening of the quarry has since exposed another section of brown dolomite of the Bertie Formation underneath the shale in the previous quarry floor. In the south face the shale measures 4.7 feet. The quarry has been deepened by another 12 feet but only 6 feet of brown, aphanitic, medium-bedded dolomite with colour lamination and black shaly parting were exposed.

A chemical analysis of a chip sample of the lower part of the quarry face is given in Table 91.

Table 91 | CHEMICAL ANALYSIS — DUNNVILLE ROCK PRODUCTS LIMITED

FEET ABOVE FLOOR	COMPONENTS IN PERCENT							
	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	L.O.I.	TOTAL	CO_2
6–12	1.68	0.07	0.83	20.8	29.8	46.4	99.58	45.0

QUARRY OPERATION

Drilling is carried out with a Gardner-Denver Air Trac drill with 3- or 3½-inch bit. The drill pattern is 7½ by 7½ feet for the lower 17-foot bench. The upper bench is 25 feet high.

Loading at the face is done by 1½-cubic yard Dominion shovel or by one of two 2-cubic yard Caterpillar front-end loaders. Stone is hauled to the crushing and screening plant by three 22-ton Euclid trucks. The rated hourly capacity of the plant has been increased to 150 tons by the addition of a 48-inch Telsmith gyratory crusher. Products are Granular "A" and "B" for road construction and aggregate for a county operated ready-mix concrete plant.

Haldimand Quarries and Construction Limited (56)

HAGERSVILLE

The quarries on lots 27 and 28, concession I, Oneida Township, Haldimand County are described by Hewitt (1960, p.140-142; 1964, p.63). The quarry south of the Michigan Central Railway is operated.

Minor changes in operation involve loading, crushing, and screening of stone. Loading at the face is done with a 4½-cubic yard, Model 980, Caterpillar front-end loader. A 6- by 14-foot Tyler screen replaces the 4- by 8-foot Niagara screen. Secondary crushing of oversizes from the screen house is carried out by two 3-foot Symons standard cone crushers, one having replaced the 6-inch gyratory crusher.

Jarvis Crushed Stone Limited (59)

JARVIS

A quarry has recently been opened on lot 23, concession XIII, Townsend Township, Norfolk County, by Jarvis Crushed Stone. The quarry is in cherty limestone of the Bois Blanc Formation. The quarry face exposes approximately 18 feet of thin- to medium-bedded, light greyish brown to grey, cherty limestone with dark grey to black shaly partings. There is an irregular bedding surface at 10.7 feet above the floor of the quarry. The limestone above this surface is a coralline biostrome. The underlying limestones are finer grained than the medium-crystalline, coralline limestone and contain a larger abundance of chert nodules and thin beds of chert; some chert patches are more than 1 foot in diameter.

A chemical analysis of a sample of ¾-inch crushed stone from the stockpile is given in Table 92.

QUARRY OPERATION

Drilling and blasting are carried out by the operator of the quarry. A portable crusher is brought in on contract when needed. A 2½-cubic yard front-end loader loads trucks with stone from the stockpiles. Three-quarter-inch crusher run and some three-quarter-inch clear stone are sold.

A weigh scale is available on the property.

R. E. Law Crushed Stone Limited (62)

PORT COLBORNE

The quarry and plant of R. E. Law Crushed Stone Limited at Port Colborne are described by Hewitt (1960, p.134-136; 1964, p.63).

QUARRY OPERATION

The 71-foot quarry section of Bois Blanc Limestone and Bertie Dolomite is quarried in three lifts of 35, 17, and 19 feet respectively, from the surface down.

Drilling is done by two Joy drills with 4-inch bits and one Reach drill for 6-inch holes. A drill pattern of 6 by 6 feet is maintained.

A 6-cubic yard Caterpillar, Model 988, front-end loader loads stone at the face. Five 35-ton Caterpillar, Model D21, trucks are available for hauling stone to the crusher, or to stockpiles after crushing.

The primary crusher is a 24-inch Telsmith, Model 25B, gyratory crusher. Crushed stone travels over a scalping screen, which takes out minus 2-inch

Table 92 — CHEMICAL ANALYSIS — JARVIS CRUSHED STONE LIMITED

COMPONENTS IN PERCENT								
SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	P_2O_5	SO_3	L.O.I.	TOTAL
34.7	0.35	0.63	0.24	36.0	0.11	0.23	28.2	100.5

stone. Plus 2-inch stone is directed to either a 4½-foot Symons standard cone crusher, a 4¼-foot Symons shorthead cone crusher, or a Stedman squirrel-cage impact crusher. The shorthead cone crusher produces mainly ⅜-inch stone whereas the impact crusher is used for production of cubical stone in sizes ranging from 2 inches to ½ inch.

Products of the Symons standard cone crusher are screened in the main screening tower by a series of Tyler screens including one 3-deck 5- by 10-foot, two double-deck 4- by 10-foot and one double-deck 4- by 16-foot screen. Two-inch, one-inch, and three-quarter-inch stone can be recrushed in a 3-foot Symons standard cone.

The product of the Symons shorthead crusher is screened on a double-deck 4- by 12-foot and a single 4- by 8-foot screen producing 1-inch, ½-inch, and ¼-inch stone and screenings. Oversizes are stockpiled or reduced to cubical stone in a second Stedman squirrel-cage impact crusher.

The ¾-inch, ½-inch, and ⅜-inch stone and products from the Symons shorthead crusher can be washed.

The rated capacity of the plant, previously 300 tons per hour, has been increased owing to the use of a front-end loader at the face. Products are mainly used for road construction and concrete aggregate. An asphalt plant and a pre-mixed concrete plant are located at the quarry.

Port Colborne Quarries Limited (85)

PORT COLBORNE

The quarry and plant of Port Colborne Quarries Limited, a division of Canada Steamship Lines, are located on a 250-acre property on Chippewa Road, east of the Welland Canal, 1 mile northeast of Port Colborne, on lots 23 and 24, concession II, Humberstone Township, Welland County. The geology and quarry operation are described by Hewitt (1960, p.130-132; 1964, p.61-62).

GEOLOGY

The quarry face is up to 55 feet high at the south boundary, including 15 feet of Bois Blanc Limestone. Four lifts are quarried. Shaly dolomite of the Bertie Formation, occurring from approximately 14 to 18 or 19 feet below the Bois Blanc contact, is blended with the cherty Bois Blanc Limestone to produce Granular "B". The remaining Bertie Dolomite above and below the shaly section is blended for production of aggregate for concrete and road construction.

The present floor of the quarry is determined by the occurrence of dark brownish grey and very shaly dolomite of which 4 feet is exposed in a partly flooded sump.

QUARRY OPERATION

Drilling of 4½-inch holes is carried out with three Joy Challenger drills. The drill pattern is 9 by 9 feet but may vary with different rocks.

Loading of stone at the face is done by a 12-cubic yard Michigan, Model 475A, front-end loader. For work on stockpiles a 7-cubic yard Michigan, two 5-cubic yard Caterpillar, and one small Trojan loader are used. Three 35-ton Mack trucks, of which another one is available as spare, haul stone to the primary crusher, a 52- by 60-inch Cedarapids impact breaker. After crushing, the plus 4-inch stone is scalped and recrushed in a 4¼-foot Symons Standard cone crusher in closed circuit with the scalping screen. Throughs go to a surge pile.

Stone from the surge pile is screened on a 2-deck scalping screen with 2-inch and ¾-inch openings. Oversizes, here 4- to 2-inch stone, can be recrushed in a 4¼-foot Symons shorthead cone crusher in closed circuit with the screen.

From the first screening tower products are conveyed by a 42-inch conveyor belt to a second tower with two separate lines of 5- by 14-foot double-deck screens. Oversizes from these screens can be recrushed in a 5½-foot Symons shorthead cone crusher. Two 6- by 16-foot double-deck rinsing screens fed by 30-inch belts are available for washing crushed stone. The products go to a Telsmith loading bin with three hoppers of a total 5,000-ton capacity. Sizes of stone produced include rubble, 4-inch, 2-inch, 1-inch, ¾-inch, ⅝-inch, ⅜-inch clear, 2-inch and ⅜-inch crusher run, and screenings. Plant capacity is 725 tons per hour. Concrete and asphalt aggregate are exported to the United States.

Ridgemount Quarries Limited (90)

STEVENSVILLE

The quarry of Ridgemount Quarries Limited, located 4 miles west of Fort Erie, on lot 3, concession VIII, Bertie Township, Welland County, is described by Hewitt (1960, p.130; 1964, p.61).

The quarry is operated in two lifts of heights varying from 30 to 40 feet for the upper lift and 17 to 18 feet for the lower lift. The section is in cherty Bois Blanc Limestone with a silty magnesian facies more common toward the base. Concrete aggregate is obtained from the lower lift.

QUARRY OPERATION

Drilling of 3-inch holes in a 6- by 7-foot pattern is carried out by a Gardner-Denver Air Trac drill.

Loading at the face is done by Koehring, Model 605, 2-cubic yard diesel shovel or by Hough, Model 120, 6-cubic yard front-end loader. An Allis-Chalmers, Model T. L. 645, 3-cubic yard front-end loader is used on stockpiles. Four 22-cubic yard Euclid trucks are available for hauling stone.

Primary crushing and screening is by 25- by 48-inch Cedarapids jaw crusher and Niagara 2-deck 4- by 12-foot screen. A scalping screen precedes the Niagara screen to take out Granular 'A' and 'B' sizes. Oversize from the Niagara screen is crushed in a secondary 4-foot Telsmith crusher and screened on a 3-deck, 4- by 10-foot screen. A tertiary 3-foot Symons standard cone crusher and additional 3-deck, 3- by 8-foot screen complete the crushing and screening cycle. Products are crusher run Granular 'A' and 'B', 1-inch, ¾-inch, and ⅜-inch stone, screenings, and fine traffic bound material. The material is used for construction of county and township roads.

DETROIT RIVER AND DUNDEE LIMESTONES

High-calcium limestone of the Detroit River Group is quarried at Beachville near Woodstock by the Steel Company of Canada Limited, Cyanamid of Canada Limited, and Domtar Chemicals Limited, and at Zorra Station, north of Beachville, by Canada Cement Lafarge Limited. It is also quarried at Amherstburg by Allied Chemical Canada Limited and Amherst Quarries Limited. In the latter quarry the Lucas Formation of the Detroit River Group is dolomitic. Limestone of the Dundee Formation is quarried at St. Marys by the St. Marys Cement Company. A cherty facies of the Dundee Limestone is quarried near Port Dover by Norfolk Quarry Company.

The Detroit River and overlying Dundee Limestone and dolomite form the bedrock surface in a band 30 to 50 miles wide extending northwest from Lake Erie through London and Woodstock to Lake Huron. These formations dip southwest and outcrop again on the west side of the broad Chatham Syncline in Essex County. Throughout most of southwestern Ontario overburden is thick, and outcrops of these formations are scarce.

Detroit River Group

In southwestern Ontario the Detroit River Group, consisting of limestone and dolomite, forms a northwest-trending band extending from Norwich through Beachville, Stratford, and Wingham to Kincardine on Lake Huron. The formations dip southwest. Southeast of Norwich the Detroit River group pinches out, and in Norfolk County between Norwich and Lake Erie, the overlying Dundee Limestone rests directly on the underlying Bois Blanc Formation. The Detroit River outcrop belt widens to 3½ miles at Beachville and from 12 to 18 miles or more, to the northwest, in the Seaforth and Kincardine areas. In this part of Ontario the Sylvania Sandstone and Anderdon Limestone are not present. For the purposes of this report the Lucas and Amherstburg Formations are not separated as they are lithologically similar and the distinction between them is made on faunal grounds.

In this belt the rocks of the Detroit River Group are divided into two facies: to the southeast of Embro and St. Marys the Detroit River is composed of limestone; to the north of St. Marys it is mainly dolomite; in the St. Marys area the dolomite and limestone facies interfinger.

The southern facies, as exposed at Beachville, consists of 100 to 110 feet of high-purity calcium limestone, medium brownish grey to tan in colour, medium crystalline to microcrystalline in texture, medium to thick bedded, with abundant corals and stromatoporoids. The description of the northern facies in the next paragraph is condensed from Best (1933).

To the north the high calcium facies changes to dolomitic facies. At St. Marys the two lithologies interfinger. In the northern part of the area where the Detroit River Group is dominantly dolomite several types of lithologies are developed. The normal dolomites of the northern facies are soft, evenly bedded, uniform, light to medium brown and fine grained. Bituminious laminae are common, and there may be a petroliferous odour. In some areas the dolomite is fine grained, thin bedded, cream coloured, and contains numerous small lath-like pieces of calcite which probably are replacements of gypsum crystals. Interbedded are thick algal biostromes of medium-grained, medium brown, crystalline dolomite in massive hummocky irregular beds.

Also in the northern facies massive, fossiliferous,

high-purity calcium limestone reefs occur in the Detroit River Group rocks. These reefs are called 'Formosa reef limestone' by E. W. Best (1953) and are a reef facies of the Detroit River. They were formerly correlated with the Alphena Limestone of Michigan but have since been re-correlated by Best with the older Detroit River Group. High-purity Formosa reef limestone is exposed near Formosa. Bruce County (see Goudge, p.210, 211, for descriptions).

The thickness of the Detroit River Group increases from 0 feet southeast of Norwich to 110 feet at Beachville, to 197 feet at St. Marys, and to 350 feet at Clinton (Best 1953). Throughout central-southwestern Ontario the Detroit River limestone and dolomite rest on the Bois Blanc cherty limestone (the Sylvania Sandstone is absent). In the Beachville area the Detroit River Limestone is overlain by up to 30 feet of buff, sandy dolomitic limestone. This facies is absent throughout the rest of the belt, and the Dundee Limestone overlies the Detroit River rocks unconformably.

In the Windsor-Amherstburg area of Essex County, where the Detroit River Group outcrops again on the western side of the Chatham Syncline it is divided into four formations as follows:

FORMATION	THICKNESS FEET
Anderdon Limestone	32
Lucas Dolomite) Amherstburg Dolomite)	200±
Sylvania Sandstone	70–100

The complete section of Anderdon Limestone, a high-purity calcium limestone 32 feet thick, is exposed in the old Allied Chemical quarry at Amherstburg, where it is overlain by 52 feet of Dundee buff dolomitic limestone and underlain by Lucas Dolomite. The Sylvania Sandstone, a fine-grained, grey to white, high-purity sandstone, has been intersected in drilling and shaft-sinking but does not outcrop. It is thin and pinches out to the east. In the Canadian Rock Salt Company's shaft at Ojibway, this sandstone was intersected between 370 and 440 feet.

BEACHVILLE AREA

The Detroit River Limestone is exposed in the valley of the Thames River for a distance of 3½ miles between Ingersoll and Woodstock. Here the Detroit River Limestone has a thickness of 100 to 110 feet and dips southwest. It is underlain in the vicinity of Woodstock by the cherty, somewhat higher magnesia-bearing limestone of the Bois Blanc Formation, and overlain by 20 to 30 feet of sandy, buff coloured, Dundee or Detroit River Limestone, which forms the cap rock at the Steel Company quarry near Ingersoll.

The 110 feet of Detroit River Limestone is characterized by its high purity and averages less than 1 percent combined silica, iron, and alumina, and less than 1 to 1.5 percent magnesia. This limestone is the thickest, most uniform, and purest high-calcium chemical limestone available in Ontario and is an important stone source for the production of chemical lime. It should be regarded as a wasting asset. Although other deposits of high-calcium limestone are avaliable, none have the thickness, uniformity, and purity of this deposit.

Drift is thin in the Thames River valley, and the entire exposed length of Detroit River Limestone is occupied by quarry operators. At the Ingersoll end of the 3½-mile section the Steel Company of Canada has a complete 100-foot section of limestone available. However, the southwest-dipping, siliceous, buff Dundee (?) Limestone cap rock covers the deposit to the southwest of the present quarry, rendering expansion of open-pit quarrying less economic in that direction. Cyanamid of Canada operates a large quarry to the northeast of the Steel Company property, and adjoining on the east is the quarry of Domtar Chemicals Limited. Since the formations dip southwest, a complete section of Detroit River Limestone is not available on the Domtar Chemicals property. The west quarry face exposes the lower 73 feet of the high-purity Detroit River Limestone. Eastward in the quarry the thickness of high-purity stone diminishes. The lower contact of high-purity stone is placed at a well marked chemical unconformity where the magnesia content exceeds 2 percent, and the silica content exceeds 1 percent. There is no marked lithologic break, but chert generally appears in the upper part of the Bois Blanc Formation, which underlies the Detroit River Limestone. The limestone dips southwest at the rate of 30 feet per mile in the Thames River valley at Beachville.

The extent of the high-purity Detroit River Limestone band is indicated on Map 2254 (back pocket). It extends along strike to the southeast of the Thames River valley for a distance of about 18 miles through West Oxford and North and South Norwich Townships, but pinches out southeast of the Town of Norwich, owing to a period of pre-Dundee erosion.

The high-purity limestone extends northwest along strike from the Beachville area, through Zorra station, where the Canada Cement plant is located, and across the Middle Branch of the Thames River west of Embro. To the north of Embro, between Embro and St. Marys, the high-purity limestone facies interfingers with the dolomite facies to the north, so that a limited area of the high-purity stone is available.

Unfortunately in the territory away from the Thames River valleys, the overburden is very thick, ranging from 60 to 300 feet or more in depth. For this reason quarrying in the high-purity Detroit River Limestone belt involves stripping of a considerable thickness of overburden. A large part of the desirable ground between the Thames River and the Middle Branch at Embro has already been taken up.

Dundee Formation (Delaware Equivalent)

The Dundee Limestone rests on the underlying Detroit River Group. The formation has a thickness of 85 to 160 feet.

Fifty feet of Dundee Limestone is exposed in the St. Marys Cement Company quarry at St. Marys. Here the formation consists of medium brownish grey to medium light grey, medium-crystalline coquinoid to fine-crystalline, thick- to medium-bedded limestone with shaly partings and some colour laminations.

Fifty-two feet of Dundee Limestone is exposed in the upper lift at the old Allied Chemical quarry in Amherstburg, where it consists of medium brownish grey, buff- to light brown-weathering, aphanitic, massive-bedded, fossiliferous, dolomitic limestone with some mottling and colour laminations. Chert is rarely present.

Allied Chemical Canada Limited (1)

AMHERSTBURG

A new quarry has been opened by Allied Chemical of Canada Limited, approximately 6 miles northeast of Amherstburg. The quarry is located in lot 10, concession VI, Anderdon Township.

Since December 1970 this quarry has provided the chemical plant with its supply of pure limestone previously obtained from quarries immediately east of the plant. Thirty-two feet of Anderdon Limestone underlain by two feet of dolomite are exposed in the new quarry face. The section is described in Table 93.

FLOOR OF QUARRY

Below the floor of the quarry the section reportedly continues in dolomite. The beds dip westerly at an angle of 2 or 3 degrees and the section is overlain by 30 to 40 feet of glacial clay. Some of the clay has been used to erect a berm visually screening the operation from the road. This berm will be planted with trees. A wire mesh fence separates the property from the road.

Chemical analyses of chip samples of the quarry face are given in Table 94.

Table 93 QUARRY SECTION — ALLIED CHEMICAL CANADA LIMITED, ANDERON TOWNSHIP

UNIT	DESCRIPTION	THICKNESS FEET
Anderdon Limestone		
AC3	Limestone: buff to very light grey; massive bedded; aphanitic to microcrystalline; fossiliferous, vuggy in part; minor colour banding 5 feet above contact	14.3
AC2	Limestone: tan to very light grey; aphanitic; medium to massive bedded; massive bedded; fossiliferous and vuggy from 2.5 to 9 feet above contact; medium to thick bedded with grey colour banding in upper part	17.8
AC1	Dolomite: calcareous; brown; aphanitic; dark grey colour banding; thick bed	2.0
	Total	34.1

Table 94 CHEMICAL ANALYSES — ALLIED CHEMICAL CANADA LIMITED

	COMPONENTS IN PERCENT							
	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	L.O.I.	TOTAL	CO_2
AC3	0.29	0.25	0.26	0.26	55.2	43.6	99.86	41.1
AC2	0.31	0.49	0.20	0.51	54.9	43.5	99.91	43.8
AC1	0.37	0.82	0.29	16.0	37.3	45.9	100.68	44.7

OPERATION

Drilling of the face of the quarry to a depth of 34 feet is done by an Ingersoll-Rand Drillmaster. Holes of 6¼-inch diameter are spaced in a 14- by 16-foot pattern. The drilling pattern may be increased to 16 by 18 feet in the future.

The quarry is operated with portable crushing and screening equipment. The primary crusher, a Telsmith Impactor crusher, is free to follow the face of the quarry in a circle sector with a 200-foot radius. Mobility is provided by two lengths of conveyor belt and an intermittent surge bin linking the primary crusher in elbow fashion to a portable secondary crushing and screening plant. This plant will move twice every year to keep up with the primary crusher.

At the face the primary crusher is fed by a Michigan, Model 475, front-end loader with a 12-cubic yard bucket. Two 6-cubic yard loaders, a Caterpillar and a Trojan, are used for work on stockpiles.

Rock from the primary crusher is conveyed to a 3-deck Telsmith screen, which screens out 2- to 6-inch stone for use in the kiln. Oversize goes to a secondary Jeffrey Impact crusher whereas minus 2-inch stone is directed to a secondary 3-deck Telsmith screen for production of different sizes of aggregate. From this screen stone can be rerouted through the secondary crusher or stockpiled by conveyor belt. Direct loading of trucks via reclaim hopper is possible at three points in the conveyor belt system.

A production of 100,000 tons of kiln stone will carry about 50,000 tons of Granular "A" aggregate as a byproduct. Initially more aggregate is being produced in the quarry to speed provision of adequate floor space. Hauling of rock to the plant in Amherstburg is contracted. A 70-foot Fairbanks-Morse weigh scale is installed at the exit of the quarry. Other facilities at the quarry include an office building and a building for equipment maintenance.

Amherst Quarries Limited (2)

AMHERSTBURG

The quarry located in lot 22, concession II, Malden Township, Essex County, 1 mile east of Amherstburg is described by Hewitt (1960, p.168; 1964, p.67-69).

The quarry is 80 feet deep and quarried in two lifts, a lower one of 30.5 feet and an upper lift of 49.5 feet. The section of the lower lift is described in Table 95.

A chemical analysis of a chip sample of the face of the lower lift is given in Table 96.

Table 95 QUARRY SECTION — AMHERST QUARRIES LIMITED, AMHERSTBURG

UNIT	DESCRIPTION	THICKNESS FEET
Lucas Formation		
Upper Lift		
AQ1 to AQ4	.....	49.5
Lower Lift		
	Dolomite: calcitic; light brownish grey, buff weathering; fine crystalline to aphanitic; massive to medium bedded; abundant white calcite and blue celestite crystals; irregular calcilutite bed with patches of calcite separates massive section below from medium bedded section above; bituminous, shaly, and stylolitic partings occur near bottom contact associated with minor clastic beds and calcilutite	23.0
	Dolomite: brown to buff; aphanitic; massive to thick bedded; colour lamination; calcite crystals; near top light grey, clastic, with dark bands of calcilutite and stylolitic partings	7.5
	Total	80.0

Table 96 CHEMICAL ANALYSIS — AMHERST QUARRIES LIMITED

COMPONENTS IN PERCENT									
SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	P_2O_5	SO_3	SO	L.O.I.	TOTAL
0.66	0.12	0.10	18.2	28.8	0.02	4.16	5.12	42.9	100.1

ODM8751

Photo 10–80 feet of thick-bedded to massive dolomites and limestones of the Detroit River Formation are exposed in the face of Amherst Quarry, Amherstburg; August 1970.

OPERATION

A Joy Heavyweight Champion drills 6¾-inch holes.

Loading at the face is done by shovel or by 5½-cubic yard Caterpillar, Model 980, front-end loader. Another 5-cubic yard Caterpillar, Model 968C, loader is used on stockpiles on the property. A 3-ton drop-ball machine crushes large blocks.

A semi-permanent crushing and screening plant is installed on the floor of the upper lift. Stone from the face is dumped by truck from a ramp into a feeder bin with grizzly that feeds a primary Cedarapids double-impactor crusher. After crushing and screening stone is stockpiled by stacker conveyor on the floor of the upper lift or directly loaded at surface from an extended conveyor belt.

Crushed stone is sold as granular base course for road construction. Riprap is produced on demand.

Canada Cement Lafarge Limited (22)

Plant No.4

WOODSTOCK

The cement plant and quarry operation at Zorra station, 6 miles west of Woodstock, are described by Hewitt (1960, p.158-161).

QUARRY OPERATION

Stripping of 70 to 80 feet of overburden by an electric walking-dragline is done in two benches. Eighty percent of the stripped material is used in the manufacture of portland cement.

Two lifts of the quarry face are drilled in a pattern of 24 by 26 feet for the upper 60-foot lift and of 19 by 20 feet for the lower 40-foot lift.

ODM8752

Photo 11–Quarry face at Zorra Station showing both limestone and overburden used in the cement making process by Canada Cement Lafarge; November 1971.

CEMENT PLANT

Changes include firing of the kilns (gas firing of the kilns became optional in July 1969) and addition of a fourth F. L. Smith Unidan grinding mill to the existing ball mills used for finish grinding of the clinker.

Production includes standard portland, high early-strength and masonry cement as well as low-heat cement, sulfate resistant cement, and cement for the cement-block industry.

Cyanamid of Canada Limited (36)

BEACHVILLE QUARRY AND LIME PLANT

The quarry and plant of Cyanamid of Canada Limited, 2 miles southwest of Beachville, are described by Hewitt (1960, p. 152-155). Another 5 years of production is expected from the present quarry after which the operation will switch to an adjacent property north of the Canadian National Railways tracks.

QUARRY OPERATION

Changes have involved loading at the face, now done by a P and H, Model 1400, 4½-cubic yard electric shovel. Two additional 28-ton Euclids and one 35-ton Haulpack truck have been acquired for hauling stone.

LIME PLANT

Two kilns on the property produce lime for use as flux in the basic oxygen furnaces of the steel industry. A new kiln was installed in 1967. It is oil-fired and has a capacity of 300 tons per day. Kiln feed varies from 2½-inch to 1-inch stone, according to demand for sizes of lime.

The new calcimatic kiln has a doughnut-shaped refractory hearth that rotates, carrying stone through two temperature zones, the highest temperature being about 2,400°F. Twenty-nine oil burners are arranged along the mantle of the hearth to provide the necessary heat. Exhaust fumes are drawn from the hearth and expelled through a chimney, preheating the fresh kiln feed in the process.

Less than 50 percent of the quarried stone is produced as lime. Production of calcium cyanamide in Niagara Falls is being phased out. More important now is the production of flux stone for the open-hearth steel furnaces and of pulverized stone for use in manufacture of glass, or as filler in plastic floor— and wall-covering. Seventy percent of this production is used in Canada.

ODM8753

Photo 12–Rotating hearth carries stone through different temperature zones in calcimatic kiln of Cyanamid of Canada Limited, Beachville; November 1971.

Eight grades of pulverized stone are produced in the pulverizing department. Fines are run through a dryer and a Joy Impact mill. Screening and air separation are applied. The finest grade is 99 percent minus 325 mesh.

Domtar Chemicals Limited (43)

BEACHVILLE QUARRY AND LIME PLANT

The Beachville quarry and lime plant of Domtar Chemicals Limited is described by Hewitt (1960, p. 149-152; 1964, p. 64). In November 1971 quarrying was carried out exclusively north of the Canadian National Railways tracks, resources to the south having been depleted in the previous year. Sixty to seventy feet of Detroit River Limestone is quarried in one bench after stripping of sixty feet of clay, minor sand, and boulders.

The quarry face is drilled with a Joy rotary drill with a 6¼-inch bit. Two front-end loaders, a Hough and a Caterpiller of respectively 5- and 6-cubic yard capacity, are used for loading at the face.

The plant has been expanded with a third rotary kiln, which is 350 feet long and 11 feet in diameter. Three vertical shaft kilns and three rotary kilns, which since 1967 can be fired by either natural gas or bunker 'C'-oil, maintain a production capacity of over 1,200 tons of high quality calcium lime per day. The products are largely used in the steel industry (80 percent) but a minor quantity goes to the pulp and paper industry and to other plants owned by Domtar. Some lime, in hydrated form, is used in control of pollution.

Norfolk Quarry Company (80)

PORT DOVER

The quarry of Norfolk Quarry Company, 2 miles northeast of Port Dover, is described by Hewitt (1964, p. 66-67).

The quarry extends along the course of an old riverbed exposing bedrock at surface. From 5 to 15 feet of overburden has been removed along the sides. The quarry face is 35 feet high in the northern part, consisting of light grey to light grey brown, grey weathering, thick-bedded, cherty, fossiliferous limestone of the Dundee Formation. White chert occurs in nodules and bands parallel to the bedding. The chert content varies from about 5 to 15 percent.

A chemical analysis of a sample of crushed stone from the stockpile is given in Table 97.

ODM8754

Photo 13–Thick-bedded Dundee Limestone is quarried in the Norfolk Quarry, Port Dover; August 1971.

Table 97 | CHEMICAL ANALYSIS – NORFOLK QUARRY, PORT DOVER

COMPONENTS IN PERCENT								
SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	P_2O_5	SO_3	L.O.I.	TOTAL
22.0	0.50	0.34	3.20	39.5	0.02	0.28	34.5	100.3

QUARRY OPERATION

Drilling in the quarry is contracted. Loading at the face is done by Linkbelt 1½-cubic yard shovel. Two 22-ton and three 15-ton Euclid trucks are used for hauling stone.

The primary crusher is a Cedarapids impact crusher. The crusher product passes over a scalping screen with 3-inch holes. Oversize is crushed in a secondary cone crusher whereas throughs go directly to a double-deck screen at the top of the screening tower. Products include 2-inch stone, ⅝-inch stone, ⅜-inch stone, chips, and dust. A 3-cubic yard Caterpillar, Model 950, front-end loader is used on stockpiles. The quarry operates 9 months per year.

St. Marys Cement Company Limited (96)

ST. MARYS PLANT

A new quarry has been opened by St. Marys Cement Company on the west side of the river, 1 mile south of Highway 7 at St. Marys. The geological section is described in Table 98. Production from this quarry started in 1968. The old quarry and cement plant are described by Hewitt (1960, p. 161-164; 1964, p. 65-66).

OPERATION

A Joy Heavyweight Champion drill is used to drill 6¾-inch holes on a 19- by 21-foot pattern.

ODM8755

Photo 14–St. Marys Quarry, west of Thames River; August 1969.

Table 98 | QUARRY SECTION – ST. MARYS CEMENT COMPANY LIMITED, WEST QUARRY

UNIT	DESCRIPTION	THICKNESS FEET
Dundee Formation		
Upper Member		
MW4	Limestone: medium to light grey, grey weathering; medium to fine crystalline; thick to medium bedded; shaly partings; coquinoid calcarenite	19.1
Lower Member		
MW3	Limestone: grey to light brownish grey, grey weathering; fine crystalline to aphanitic; massive bedded; fossiliferous calcarenite; 0.1-foot brown shale included; thick to medium bedded; coralline calcirudite at top	17.7
Detroit River Group		
MW2	Limestone: brown to brownish grey, brown to rusty weathering; aphanitic; thick to medium bedded; colour lamination or banding; shaly partings; rusty seam at top contact	6.0
MW1	Limestone: tan to brown, creamy white weathering; fine crystalline to aphanitic; thick to thin bedded; colour laminations	15.2
	Total	58.0

A Bucyrus-Erie Model 110B 5-cubic yard shovel is used for loading at the face. Three 35-ton Euclid trucks haul rock to the primary 54-inch gyratory Traylor crusher installed in the quarry. Four and one half inch stone is transported across the river to a secondary crusher via an 1800-foot conveyor belt to a surge pile at the plant.

Stripping is done by a Marion Model 101M electric shovel. The overburden, up to 25 feet of gravel covering the even surface of the limestone, is temporarily stored. A 4½-cubic yard Caterpillar front-end loader and a Caterpillar bulldozer are available on the property.

Steel Company of Canada (97) *(Chemical Lime Works)*

INGERSOLL

The quarry and lime plant of the Chemical Lime Works, Steel Company of Canada, 1 mile northeast of Ingersoll and 3 miles southwest of Beachville, is described by Hewitt (1960, p.155-158; 1964, p.65).

Three natural gas-fired vertical-shaft kilns and a rotary kiln are in operation. The plant provides a large part of the flux requirements of the company's iron and steel making facilities in Hamilton. There is still a supply of stone available, estimated to be sufficient for 100 years production at present rates.

ODM8756

Photo 15–Rotary kiln producing 325 tons of blast furnace flux per day for Steel Company of Canada, Ingersoll; November 1971.

GEOLOGY

The sandy, buff limestone of the Dundee Formation (formerly Columbus Formation), overlying the high-purity Detroit River Limestone, increases in thickness from 20 feet at the present quarry face to about 30 feet at the southwest boundary of the property consistent with the general dip of formations. It is quarried separately and sold as riprap. Together with overburden, averaging a thickness of 20 feet, this cap rock has to be removed before the productive limestone section can be quarried. However, a maximum thickness of cap rock of 32 feet at the southwest boundary of the quarry, is no longer prohibitive for quarry operation in that area.

QUARRY OPERATION

Present quarrying takes place in the east end of the property. The lower lift of 58 feet is drilled on a 21- by 21-foot pattern.

CRUSHING AND SCREENING

The primary crusher, a 48- by 60-inch, Traylor jaw-crusher, is located on the bench at the top of No. 1 lift in the quarry. The stone is carried from the jaw-crusher to the secondary crusher-building by a 42-inch conveyor, which discharges on a 5- by 14-foot, F 800, single-deck scalping screen with a split deck having 4½- and 10-inch openings. The plus 10-inch stone goes to the secondary crusher, a single rotor, Model 4442 Universal Impact Master set at 4½ inches. The 10- by 4½-inch stone is conveyed either to a bin for blast furnace flux stone or to the secondary crusher. The minus 4½-inch stone goes to a 2-deck, 5- by 12-foot, F600 screen with 1½- and ⅜-inch openings. The 4½- by 1½-inch stone and the 1½- by ⅜-inch stone are conveyed on a 36-inch belt to the screen house. The minus ⅜-inch crushed stone goes via separate 20-inch conveyor to the minus ⅜-inch wet fines bin.

SCREEN HOUSE

The 36-inch conveyor to the screen house discharges on a 2-deck, 6- by 14-foot, F800 screen with 4½-inch and 2¼-inch openings. The plus 4½-inch stone goes to the bin for open hearth flux. The 4½- by 2¼-inch stone goes into storage silos to be used as shaft kiln feed stone.

The 2¼-inch throughs go via two 30-inch transfer conveyors to two F 880 3-deck screens with 1¾-inch, ¾-inch, and 3/16-inch openings. The 2¼- by 1¾-inch, 1¾- by ¾-inch, the ¾- by 3/16-inch, and the minus 3/16-inch crushed stone go to separate bins. These sizes are used for various flux and asphalt-aggregate requirements; rotary kiln feed will leave only ½-inch stone for use as asphalt aggregate.

A pulverized stone plant produces minus 3/16-inch sinter flux stone from the minus 2-inch stone. The plant consists of a C38 Pennsylvania impactor in closed circuit with twin Nordberg rod-deck screens.

A new installation for handling and loading of products on trucks or railway cars, with added storage capacity of 3,000 tons in 4 bins, is part of a recent expansion program. Crushing and screening of lime and the manufacture of lime briquets for dust control during transport are now carried out.

LIME PLANT

A lime plant consisting of three vertical-shaft kilns, each with a capacity of 100 tons of lime per 24 hours, went into production in 1959. The kilns are fired with natural gas and use 4½- to 2¼-inch stone.

In 1971 a natural gas fired K.V.S.-rotary kiln was added. The 325-ton per day kiln doubles plant capacity. It is fed with 1½- to ½-inch stone, which sizes are presently in demand for blast furnace flux. Temperatures in the kiln range from 1900°F at feed-in to 2600°F at discharge.

Hamilton Limestone

Thin beds of grey medium-crystalline limestone occur in the Hamilton Formation of southwestern Ontario. The formation is principally grey shale. A small quarry was opened by A. G. Cook near Thedford in a thin limestone band in the Hamilton Formation.

A. G. Cook Quarry (30)

THEDFORD QUARRY

The quarry operated 1 mile north of Thedford on the west side of Highway 82 by A. G. Cook Limited has been described by Hewitt (1964, p.70).

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Geological Map

Map 2264 (coloured)–Ontario Limestone Quarries, 1971. Scale, 1 inch to 16 miles.